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ABSTRACT

This Occupational Competency Analysis Profile (OCAP) for commercial truck and equipment technician is an employer-verified competency list that evolved from a modified DACUM (Developing a Curriculum) job analysis process involving business, industry, labor, and community agency representatives throughout Ohio. The task list of the National Automotive Technicians Education Foundation (NATEF) makes up units 1-8 of the OCAP, covering the 8 truck areas that may be certified: (1) gasoline engines; (2) diesel engines; (3) drive train; (4) suspension and steering; (5) brakes; (6) electrical and electronic systems; (7) heating and air conditioning; and (8) preventive maintenance inspection. Unit 9 contains additional competencies important to the success of entry-level auto collision technicians in Ohio. Competencies for employability also are listed. Each OCAP identifies the occupational, academic, and employability skills (competencies), clustered into broader subunits and units, and coded by priorities needed to enter a given occupation or occupational area. The OCAP guide also includes an academic job profile showing levels of proficiency in academic areas needed for commercial truck and equipment technicians; a total list of academic competencies as well as a list of the competencies needed for these occupations; and a list of the members of the verification panels. (KC)

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# OCAP

## OCCUPATIONAL COMPETENCY ANALYSIS PROFILE

# COMMERCIAL TRUCK/ EQUIPMENT TECHNICIAN

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# Introduction

## What is an OCAP?

According to the *Action Plan for Accelerating the Modernization of Vocational Education: Ohio's Future at Work*—

> A comprehensive and verified employer competency list will be developed and kept current for each program
>
> —Imperative 3, Objective 2—

The Occupational Competency Analysis Profiles (OCAPs) are the Ohio Division of Vocational and Career Education's response to that objective.

OCAPs are employer-verified competency lists, which, in general, evolve from a modified DACUM job analysis process involving business, industry, labor, and community agency representatives from throughout Ohio. The OCAP process is directed by the Vocational Instructional Materials Laboratory (VIML) located at The Ohio State University's Center on Education and Training for Employment.

To facilitate the preparation of students for certification by the Board of the National Institute for Automotive Service Excellence (ASE), however, the task list of the National Automotive Technicians Education Foundation (NATEF) forms the bulk of this OCAP (Units 1-8). The NATEF Task List in the *ASE Program Certification Standards for Medium/Heavy Truck Technician Training Programs* was reviewed and updated in December 1993 by a panel representing the major truck manufacturers, truck repair shop owners and technicians, truck instructors, truck equipment and parts suppliers, and state trade and industrial (T&I) education supervisors. The resulting NATEF units cover the eight truck areas that may be certified: (1) diesel engines, (2) suspension and steering, (3) brakes, (4) electrical/electronic systems, (5) preventive maintenance inspection, (6) gasoline engines, (7) drive train, and (8) heating and air conditioning. The first five units in that list are required for minimum certification or recertification.

Unit 6 contains those additional competencies identified by the panel of expert workers convened by the VIML as being important to the success of entry-level auto collision technicians in Ohio.

## How is the OCAP used?

Each OCAP identifies the occupational, academic, and employability skills (or competencies) needed to enter a given occupation or occupational area.

The NATEF section of this OCAP (Units 1-8) lists all the job tasks (*competencies*) important to the commercial truck/equipment technician area, clustered into broader *subunits* and *units*. All competencies are coded with a priority designation:

***Priority 1 (P-1)***

Certified programs must include 95% of the P-1 tasks in the curriculum.

- ***Priority 2 (P-2)***

  Certified programs must include 80% of the P-2 tasks in the curriculum.

- ***Priority 3 (P-3)***

  Certified programs must include 25% of the P-3 tasks in the curriculum.

The Ohio-specific section of the Commercial Truck/Equipment Technician OCAP (Unit 9) not only lists the *competencies* but also clusters those competencies into broader *units* and details the knowledge, skills, and attitudes (*competency builders*) needed to perform each competency. Within the competency list are two levels of items: core and advancing. *Core items* are those competencies identified by a panel of subject-matter experts as critical to entry-level employment in Ohio. *Advancing items* (marked with an asterisk) are those needed to advance in the occupation.

School districts may add as many units, competencies, and/or competency builders as desired to reflect local employment needs, trends, and specialties. Local advisory committees should be actively involved in the identification and verification of additional items. Instructors will be able to formulate their vocational courses of study using the OCAP for their occupational area and will be able to monitor competency gains via the new criterion-referenced competency testing program, which is tied to the competencies identified on the OCAP.

## Teacher Review Panel

OCAPs are updated using materials located through an extensive review of the literature. The Vocational Instructional Materials Laboratory wishes to extend thanks and appreciation to the panel of teachers that reviewed this updated OCAP prior to verification to fine-tune and polish it for presentation to the subject-matter experts on the verification panel. The following teachers served on the Commercial Truck/Equipment Technician Teacher Review Panel:

Joe G. Joiner, *EHOVE Career Center*, Milan, Ohio

Don Schwier, *Colerain Career Center*, Cincinnati, Ohio

John J. Tamas, *Lorain County Joint Vocational School*, Oberlin, Ohio

Terry Vickers, *Wayne County Career Center*, Smithville, Ohio

# Occupational Competency Analysis Profile:

# Commercial Truck/ Equipment Technician

## NATEF Task List Priority Item Totals (by area)

Unit 1: Gasoline Engines
- P-1 = 20
- P-2 = 45
- P-3 = 32

Unit 2: Diesel Engines
- P-1 = 19
- P-2 = 43
- P-3 = 44

Unit 3: Drive Train
- P-1 = 3
- P-2 = 31
- P-3 = 30

Unit 4: Suspension and Steering
- P-1 = 16
- P-2 = 26
- P-3 = 21

Unit 5: Brakes
- P-1 = 7
- P-2 = 51
- P-3 = 7

Unit 6: Electrical/Electronic Systems
- P-1 = 13
- P-2 = 33
- P-3 = 13

Unit 7: Heating and Air Conditioning
- P-1 = 10
- P-2 = 23
- P-3 = 19

Unit 8: Preventive Maintenance Inspection
- P-1 = 45
- P-2 = 0
- P-3 = 0

ASE-certified programs must include in the curriculum:

- 95% of the P-1 tasks
- 80% of the P-2 tasks
- 25% of the P-3 tasks

## Ohio Task List Priority Item Totals (by area)

Unit 9: Basic Shop and Safety Practices
- P-1 = 5
- P-2 = 4
- P-3 = 1

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## NATEF Task List

The NATEF Task List from the *ASE Program Certification Standards for Medium/Heavy Truck Technician Training Programs* is reprinted here with permission.

NOTE: For every competency in this NATEF list, the following safety task must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; and the handling, storage, and disposal of chemicals and hazardous materials in accordance with local, state, and federal safety and environmental regulations.

# Unit 1: Gasoline Engines

**Subunit 1.1: General Engine Diagnosis; Removal and Reinstallation (R & R)**

*Competencies:*

| | | |
|---|---|---|
| 1.1.1 | Verify and interpret complaint; determine needed repairs. | P-2 |
| 1.1.2 | Inspect engine assembly for fuel, oil, coolant, and other leaks; identify and determine needed repairs. | P-2 |
| 1.1.3 | Interpret engine noises; determine needed repairs. | P-3 |
| 1.1.4 | Diagnose the cause of excessive oil consumption, unusual engine exhaust color, odor, and sound; determine needed repairs. | P-3 |
| 1.1.5 | Diagnose engine mechanical problems; determine needed repairs. | P-2 |
| 1.1.6 | Perform engine vacuum tests; determine needed repairs. | P-2 |
| 1.1.7 | Perform cylinder power balance tests; determine needed repairs. | P-3 |
| 1.1.8 | Perform cylinder compression tests; determine needed repairs. | P-1 |
| 1.1.9 | Perform cylinder leakage tests; determine needed repairs. | P-2 |
| 1.1.10 | Remove engine; prepare for tear down. | P-3 |
| 1.1.11 | Reinstall engine. | P-3 |
| 1.1.12 | Diagnose ignition or fuel problems with an exhaust gas analyzer, an oscilloscope, and/or engine analyzer; determine needed repairs. | P-1 |
| 1.1.13 | Perform diagnostic procedures on vehicle with on-board or self-diagnostic type computer systems; determine needed repairs. | P-1 |
| 1.1.14 | Perform diagnostic procedures on vehicle computer system using scan tools; determine needed repairs. | P-1 |
| 1.1.15 | Inspect and test sensor, actuator components, and circuits of electronic engine management systems; adjust or replace as needed. | P-1 |

**Subunit 1.2: Cylinder Head and Valve Train Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 1.2.1 | Remove and clean cylinder head(s); visually inspect cylinder heads for cracks; check gasket surface areas for warpage and leakage; check passage condition. | P-2 |
| 1.2.2 | Install cylinder head(s) and gaskets. | P-2 |
| 1.2.3 | Inspect and test valve springs for squareness, tension, and free height comparison; replace as necessary. | P-3 |
| 1.2.4 | Inspect valve spring retainers, locks, and valve lock grooves. | P-3 |
| 1.2.5 | Replace valve stem seals. | P-3 |
| 1.2.6 | Inspect valve guides for wear; check valve guide height and stem-to-guide clearance; recondition/replace as needed. | P-3 |
| 1.2.7 | Inspect valves; resurface or replace as needed. | P-3 |
| 1.2.8 | Inspect valve seats; resurface or replace as needed. | P-3 |
| 1.2.9 | Check valve face-to-seat contact and valve seat concentricity (runout); service seats and valves as needed. | P-3 |
| 1.2.10 | Check valve spring assembled height and valve stem height; service valve and spring assemblies as needed. | P-3 |
| 1.2.11 | Inspect pushrods, rocker arms, rocker arm pivots, and shafts for wear, bending, cracks, looseness, and blocked oil passages; repair or replace as needed. | P-2 |
| 1.2.12 | Inspect and test hydraulic or mechanical lifters; replace as needed. | P-2 |
| 1.2.13 | Adjust valves. | P-1 |
| 1.2.14 | Inspect and replace camshaft drives; check gear wear and backlash, sprocket, and chain wear; time camshaft. | P-1 |
| 1.2.15 | Inspect and measure camshaft journals and lobes. | P-2 |

**Subunit 1.3: Engine Block Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 1.3.1 | Inspect pans, covers, gaskets, and seals; replace as needed. | P-2 |
| 1.3.2 | Inspect engine block for cracks, passage condition, core and gallery plug condition, thread condition, and surface warpage; determine needed repairs. | P-2 |
| 1.3.3 | Remove cylinder wall ridges. | P-3 |
| 1.3.4 | Inspect and measure cylinder walls for damage and wear; determine needed repairs. | P-2 |
| 1.3.5 | Hone and clean cylinder walls. | P-3 |
| 1.3.6 | Inspect and measure camshaft bearing bores for wear, damage, out-of-round, and alignment; determine needed repairs. | P-3 |
| 1.3.7 | Inspect crankshaft for surface cracks and journal damage; check oil passage condition; measure journal and seal surface wear; determine needed repairs. | P-3 |
| 1.3.8 | Inspect and measure main and connecting rod bearings for damage, wear patterns, clearance, and end play; determine needed repairs. | P-3 |

*Continued*

***Subunit 1.3:*** ***Engine Block Diagnosis and Repair****—Continued*

| | | |
|---|---|---|
| 1.3.9 | Identify piston wear patterns that indicate connecting rod alignment and main bearing bore problems; determine needed repairs. | P-3 |
| 1.3.10 | Clean, inspect, and measure pistons; service or replace as needed. | P-3 |
| 1.3.11 | Install new piston pins and bushings (as applicable). | P-3 |
| 1.3.12 | Inspect, measure, and install piston rings. | P-3 |
| 1.3.13 | Inspect crankshaft vibration damper (harmonic balancer); replace as needed. | P-2 |
| 1.3.14 | Inspect crankshaft flange and flywheel/flexplate mating surfaces for burrs; measure runout; repair as needed. | P-3 |
| 1.3.15 | Inspect flywheel/flexplate for cracks, wear (includes ring gear), and measure runout; determine needed repairs. | P-3 |
| 1.3.16 | Reassemble engine using correct gaskets, sealants, and fasteners. | P-1 |
| 1.3.17 | Prelube engine lubrication system. | P-2 |

**Subunit 1.4: Lubrication and Cooling Systems Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 1.4.1 | Check engine oil level, condition, and consumption; determine needed repairs. | P-1 |
| 1.4.2 | Perform oil pressure tests; determine needed repairs. | P-2 |
| 1.4.3 | Inspect and measure oil pumps (includes gears, rotors, and housing), pressure relief devices, and pump drives; replace as needed. | P-3 |
| 1.4.4 | Inspect oil pressure regulator valve(s), by-pass and pressure relief valve(s), and filters; repair or replace as needed. | P-2 |
| 1.4.5 | Perform cooling system tests (pressure, combustion leakage, and temperature); determine needed repairs. | P-2 |
| 1.4.6 | Inspect drive belts and pulleys; replace and adjust as needed. | P-1 |
| 1.4.7 | Inspect engine cooling and heater system hoses; replace as needed. | P-2 |
| 1.4.8 | Inspect and test thermostat, by-pass, and housing; replace as needed. | P-2 |
| 1.4.9 | Test and inspect coolant; drain, flush, and refill with recommended coolant; bleed cooling system. | P-1 |
| 1.4.10 | Inspect water pump; replace as needed. | P-2 |
| 1.4.11 | Inspect and test radiator, pressure cap, and coolant recovery system; replace as needed. | P-1 |
| 1.4.12 | Clean, inspect, and test fan(s) (electrical and mechanical), fan clutch, fan shroud, and cooling system related temperature sensors/switches; replace as needed. | P-2 |
| 1.4.13 | Inspect and test oil coolers; determine needed repairs. | P-3 |
| 1.4.14 | Inspect and test oil temperature/pressure switches and sensors; replace as needed. | P-2 |
| 1.4.15 | Perform oil and filter change. | P-1 |

## Subunit 1.5: Ignition System Diagnosis and Repair

*Competencies:*

| | | |
|---|---|---|
| 1.5.1 | Diagnose no-starting, hard starting, engine misfire, poor driveability, excessive emissions, detonation (pinging), power loss, or poor mileage problems on vehicle with electronic ignition systems; determine needed repairs. | P-1 |
| 1.5.2 | Inspect and test ignition primary circuit wiring and components; repair or replace as needed. | P-2 |
| 1.5.3 | Remove distributor, inspect and test internal components; reinstall distributor. | P-3 |
| 1.5.4 | Inspect, test, and service ignition system secondary circuit wiring and components; replace as needed. | P-2 |
| 1.5.5 | Inspect and test ignition coil; replace as needed. | P-2 |
| 1.5.6 | Check and adjust ignition system timing; verify timing advance. | P-1 |
| 1.5.7 | Inspect and test electronic ignition wiring harness and connectors; replace as needed. | P-2 |
| 1.5.8 | Inspect and test electronic ignition system pick-up sensor or trigger devices; replace as needed. | P-2 |
| 1.5.9 | Inspect and test electronic ignition system control unit (module); replace as needed. | P-2 |
| 1.5.10 | Test the operation of spark control system; determine needed repairs. | P-2 |

## Subunit 1.6: Fuel and Exhaust Systems Diagnosis and Repair

*Competencies:*

| | | |
|---|---|---|
| 1.6.1 | Diagnose no-starting, hard starting, poor idle, flooding, hesitation, surging, engine misfire, excessive emissions, power loss, poor mileage, and/or dieseling problems on vehicle with carburetor-type fuel systems; determine needed repairs. | P-2 |
| 1.6.2 | Diagnose no-starting, hard starting, poor idle, flooding, hesitation, surging, engine misfire, excessive emissions, power loss, poor mileage, and/or dieseling problems on vehicle with injection-type fuel systems; determine needed repairs. | P-2 |
| 1.6.3 | Inspect fuel tank, fuel gauge sending unit, fuel tank filter (sock), fuel cap, fuel lines, fuel filters, and hoses; replace as needed. | P-2 |
| 1.6.4 | Check fuel quality and condition. | P-2 |
| 1.6.5 | Inspect and test (pressure, vacuum, and volume) fuel pumps and pump controls (electrical/electronic); replace as needed. | P-2 |
| 1.6.6 | Inspect, clean, adjust, and test cold-enrichment systems; repair or replace as needed. | P-3 |
| 1.6.7 | Remove and reinstall carburetor/fuel injection throttle body; adjust related linkages. | P-2 |
| 1.6.8 | Rebuild carburetor (includes disassembling, cleaning, replacing faulty parts, and reassembly). | P-3 |
| 1.6.9 | Inspect and clean carburetor mounting plates, fuel injection air induction system, intake manifold, and gaskets; replace as needed. | P-3 |
| 1.6.10 | Adjust carburetor idle speed and fuel mixture. | P-3 |

*Continued*

***Subunit 1.6:*** ***Fuel and Exhaust Systems Diagnosis and Repair—Continued***

| | | |
|---|---|---|
| 1.6.11 | Inspect, test, and clean components of fuel injection system; adjust or replace as needed. | P-2 |
| 1.6.12 | Inspect air cleaner assembly and filter elements; replace as needed. | P-1 |
| 1.6.13 | Perform fuel injector tests (resistance, current, spray pattern, flow, and pressure drop). | P-2 |
| 1.6.14 | Inspect and test exhaust manifold, exhaust pipes, mufflers, resonators, tail pipes, catalytic converter, and heat shields; reinstall or replace as needed. | P-2 |

**Subunit 1.7:** **Emissions Control Systems Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 1.7.1 | Inspect and test the positive crankcase ventilation (PCV) systems; determine needed repairs. | P-1 |
| 1.7.2 | Test the operation of the exhaust gas recirculation (EGR) system. | P-1 |
| 1.7.3 | Inspect and clean EGR valves, valve manifolds, controls and hoses, and exhaust passages of exhaust gas recirculation (EGR) system; replace as needed. | P-2 |
| 1.7.4 | Test the operation of air injection reaction (AIR) system. | P-1 |
| 1.7.5 | Inspect and service pumps, pressure relief valves, filters, pulleys, belts, control valves, and vacuum hoses of air injection reaction (AIR) system; replace as needed. | P-2 |
| 1.7.6 | Inspect hoses, check valves, air manifolds, and injectors of air injection reaction (AIR) system; replace as needed. | P-3 |
| 1.7.7 | Test the operation of fuel vapor control system; determine needed repairs. | P-1 |
| 1.7.8 | Inspect liquid/vapor separator, liquid check valve, lines, and hoses of fuel vapor control system; service or replace as needed. | P-2 |
| 1.7.9 | Inspect canister, purge lines, and filter of fuel vapor control system; service or replace as needed. | P-2 |
| 1.7.10 | Test the operation of inlet air temperature control system; determine needed repairs. | P-2 |
| 1.7.11 | Inspect and test early fuel evaporator (EFE) components, sensors, heat stove shroud, hot air pipe, and damper of inlet air temperature control system; replace as needed. | P-2 |

# Unit 2: Diesel Engines

## Subunit 2.1: General Engine Diagnosis

*Competencies:*

| | | |
|---|---|---|
| 2.1.1 | Listen to and verify operator's complaint; review past maintenance documents; determine needed repairs. | P-2 |
| 2.1.2 | Inspect fuel, oil, and coolant levels and condition; determine needed repairs. | P-1 |
| 2.1.3 | Inspect engine assembly and compartment for fuel, oil, coolant, air, and other leaks; determine needed repairs. | P-2 |
| 2.1.4 | Interpret engine noises; determine needed repairs. | P-3 |
| 2.1.5 | Check engine exhaust smoke color and quantity; determine needed repairs. | P-2 |
| 2.1.6 | Perform air intake system restriction and/or pressure test; determine needed repairs. | P-2 |
| 2.1.7 | Perform manifold pressure and/or air box pressure tests; determine needed repairs. | P-2 |
| 2.1.8 | Perform exhaust back pressure tests; determine needed repairs. | P-2 |
| 2.1.9 | Perform crankcase pressure test; determine needed repairs. | P-2 |
| 2.1.10 | Diagnose no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed repairs. | P-1 |
| 2.1.11 | Diagnose surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed repairs. | P-2 |
| 2.1.12 | Diagnose engine vibration problems; determine needed repairs. | P-2 |
| 2.1.13 | Locate a misfiring cylinder; determine needed repairs. | P-1 |

## Subunit 2.2: Cylinder Head and Valve Train Diagnosis and Repair

*Competencies:*

| | | |
|---|---|---|
| 2.2.1 | Remove, clean, inspect for visible damage, and replace cylinder head(s) assembly. | P-2 |
| 2.2.2 | Clean and inspect threaded holes, studs, and bolts for serviceability; service or replace as needed. | P-1 |
| 2.2.3 | Inspect cylinder head and mating surfaces for warpage and thickness; inspect for cracks/damage; check condition of passages; inspect core and gallery plugs; determine needed repairs. | P-2 |
| 2.2.4 | Pressure test cylinder head; determine needed repairs. | P-3 |
| 2.2.5 | Inspect and test valve springs for squareness, tension, and free height comparison; replace as needed. | P-3 |
| 2.2.6 | Inspect valve spring retainers and/or rotators and locks; replace as needed. | P-3 |
| 2.2.7 | Measure valve guides for wear, check valve guide-to-stem clearance, and measure valve guide height; replace as needed. | P-3 |
| 2.2.8 | Inspect valves; recondition or replace as needed. | P-3 |
| 2.2.9 | Inspect valve seats; recondition or replace as needed. | P-3 |

*Continued*

***Subunit 2.2:*** ***Cylinder Head and Valve Train Diagnosis and Repair—Continued***

| | | |
|---|---|---|
| 2.2.10 | Measure valve head height relative to deck, valve face-to-seat contact, and valve seat concentricity; service seats and valves as needed. | P-3 |
| 2.2.11 | Inspect injector sleeves and seals; replace; measure injector tip or nozzle protrusion. | P-3 |
| 2.2.12 | Clean and inspect precombustion chambers; replace as needed. | P-3 |
| 2.2.13 | Inspect valve bridges (crossheads) and guides; replace and adjust bridges as needed. | P-3 |
| 2.2.14 | Reassemble cylinder head; vacuum test valve sealing. | P-3 |
| 2.2.15 | Inspect, measure, and replace/reinstall overhead camshaft; measure/adjust end play and backlash. | P-3 |
| 2.2.16 | Inspect pushrods, rocker arms, rocker arm shafts, and brackets for wear, bending, cracks, looseness, and blocked oil passages; repair or replace as needed. | P-2 |
| 2.2.17 | Inspect and adjust cam followers; replace as needed. | P-3 |
| 2.2.18 | Adjust valve clearance as needed. | P-1 |

**Subunit 2.3:** **Engine Block Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 2.3.1 | Inspect, service, and install pans, covers, vents, gaskets, seals, and wear rings. | P-2 |
| 2.3.2 | Clean engine block; inspect for cracks; measure mating surfaces for warpage; check condition of passages, core, and gallery plugs; inspect threaded holes, studs, dowel pins, and bolts for serviceability; service or replace as needed. | P-2 |
| 2.3.3 | Pressure test engine block; determine needed repairs. | P-3 |
| 2.3.4 | Inspect cylinder sleeve counterbore and lower bore; check bore distortion; determine needed service. | P-3 |
| 2.3.5 | Clean, inspect, and measure cylinder walls or liners for wear and damage; determine needed service. | P-3 |
| 2.3.6 | Replace cylinder liners and seals; check and adjust liner height. | P-3 |
| 2.3.7 | Inspect camshaft bearings for wear patterns and damage; determine needed repairs. | P-3 |
| 2.3.8 | Inspect, measure, and replace/reinstall in-block camshaft; measure/adjust end play. | P-3 |
| 2.3.9 | Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passage(s); check passage plugs; measure journal diameter; determine needed service. | P-3 |
| 2.3.10 | Inspect (wear patterns) and replace main bearings; check bearing clearances; check and adjust crankshaft end play. | P-3 |
| 2.3.11 | Inspect, replace, and time gear train. | P-2 |
| 2.3.12 | Clean, inspect (wear patterns), and measure pistons, pins, retainers, and connecting rods; replace as needed. | P-2 |
| 2.3.13 | Measure piston-to-cylinder wall clearance. | P-3 |
| 2.3.14 | Check ring-to-groove clearance and end gap; install rings on pistons. | P-3 |

*Continued*

***Subunit 2.3:*** ***Engine Block Diagnosis and Repair—Continued***

| | | |
|---|---|---|
| 2.3.15 | Assemble pistons and connecting rods; install in block; replace rod bearings and check clearances. | P-2 |
| 2.3.16 | Check piston cooling jets (nozzles) condition, position, and clearances. | P-2 |
| 2.3.17 | Inspect, measure, and service crankshaft vibration damper; replace as needed. | P-2 |
| 2.3.18 | Inspect, install, and align flywheel housing. | P-3 |
| 2.3.19 | Inspect crankshaft flange and flywheel/flexplate mating surfaces for burrs; measure runouts; repair as needed. | P-3 |
| 2.3.20 | Inspect flywheel/flexplate for cracks, wear (includes ring gear), and measure runout; determine needed repairs. | P-3 |

**Subunit 2.4:** **Lubrication Systems Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 2.4.1 | Check engine oil pressure, gauge, and sending unit. | P-1 |
| 2.4.2 | Check engine oil level, condition, and consumption; determine needed repairs. | P-1 |
| 2.4.3 | Inspect, measure, and repair oil pump, drives, inlet pipes, and screens; replace as needed. | P-2 |
| 2.4.4 | Inspect oil pressure regulator valve(s), by-pass and pressure relief valve(s), and filters; repair or replace as needed. | P-2 |
| 2.4.5 | Inspect, clean, test, reinstall/replace, and align oil cooler; test, reinstall/replace differential valve and thermostat; inspect and repair/replace lines and hoses. | P-3 |
| 2.4.6 | Inspect turbocharger lubrication system; determine needed repairs. | P-2 |

**Subunit 2.5:** **Cooling System Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 2.5.1 | Check engine coolant level, condition, and consumption; determine needed repairs. | P-1 |
| 2.5.2 | Check coolant temperature, gauge, and sending unit. | P-2 |
| 2.5.3 | Inspect drive belts and tensioners; reinstall or replace and adjust as needed. | P-1 |
| 2.5.4 | Inspect thermostat, by-passes, housing(s), and seals; replace as needed. | P-2 |
| 2.5.5 | Test conditioner and coolant concentration levels; determine needed repairs. | P-1 |
| 2.5.6 | Flush and refill cooling system; bleed air from system. | P-1 |
| 2.5.7 | Inspect coolant conditioner/filter, check valves, lines, and fittings; replace as needed. | P-2 |
| 2.5.8 | Inspect water pump, hoses, and idler pulley; repair or replace as needed. | P-2 |
| 2.5.9 | Inspect, clean, and pressure test radiator, pressure cap, and tank(s) and recovery systems; determine needed repairs. | P-2 |
| 2.5.10 | Inspect fan hub, fan, fan clutch, controls, thermostat, and fan shroud; repair or replace as needed. | P-3 |
| 2.5.11 | Inspect radiator shutter assembly and controls; repair or replace as needed. | P-3 |

**Subunit 2.6: Air Induction and Exhaust Systems Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 2.6.1 | Inspect air induction piping, air cleaner, and element; service or replace as needed. | P-1 |
| 2.6.2 | Inspect turbocharger, and waste gate/engine driven blowers and piping systems; determine needed repairs. | P-2 |
| 2.6.3 | Remove and reinstall turbocharger and waste gate/engine driven blowers. | P-3 |
| 2.6.4 | Inspect intake manifold, gaskets, and connections; repair or replace as needed. | P-2 |
| 2.6.5 | Inspect, clean, and test aftercooler (intercooler) and charge air cooler assemblies; repair or replace as needed. | P-2 |
| 2.6.6 | Inspect exhaust manifold, piping, mufflers, and mounting hardware; repair or replace as needed. | P-2 |
| 2.6.7 | Inspect preheater (glow plug) system and controls; repair or replace as needed. | P-3 |
| 2.6.8 | Inspect ether/starting fluid system and controls; repair or replace as needed. | P-3 |
| 2.6.9 | Inspect emergency air induction shut-off system; repair or replace as needed. | P-3 |

**Subunit 2.7: Fuel System Diagnosis and Repair: General Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 2.7.1 | Check fuel level, quality, and consumption; determine needed repairs. | P-1 |
| 2.7.2 | Inspect fuel tanks, vents, cap(s), mounts, screens, supply, crossover, and return lines and fittings; determine needed repairs. | P-1 |
| 2.7.3 | Inspect, clean, test fuel transfer (lift) pump, pump drives, screens, water separators, filters, heaters, and mounting hardware; determine needed repairs. | P-1 |
| 2.7.4 | Check fuel system for air; determine needed repairs. | P-1 |
| 2.7.5 | Prime and bleed fuel system; check primer pump; determine needed repairs. | P-1 |
| 2.7.6 | Perform on-engine inspections; remove, test, adjust injectors (and nozzles); determine needed repairs. | P-2 |
| 2.7.7 | Inspect high pressure injection lines, fitting, and seals; replace as needed. | P-2 |
| 2.7.8 | Inspect low pressure fuel lines, fittings, and seals; repair or replace as needed. | P-2 |
| 2.7.9 | Inspect, test, and adjust safety shut-down devices, circuits, and sensors; determine needed repairs. | P-3 |

**Subunit 2.8: Fuel System Diagnosis and Repair: Mechanical Fuel Injection Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 2.8.1 | Perform on-engine inspections, tests, adjustments; check timing or replace and time a distributor (rotary) type injection pump; determine needed repairs. | P-2 |
| 2.8.2 | Perform on-engine inspections, tests, adjustments; check timing or replace and time an in-line type injection pump; determine needed repairs. | P-2 |
| 2.8.3 | Perform on-engine inspections, tests, and adjustments; replace a PT-type injection pump and injectors as needed. | P-2 |
| 2.8.4 | Inspect and adjust throttle control linkage; determine needed repairs. | P-1 |
| 2.8.5 | Inspect smoke limiters (air/fuel ratio controls); determine needed repairs. | P-3 |
| 2.8.6 | Inspect, test, and adjust engine governors; determine needed repairs. | P-3 |
| 2.8.7 | Inspect, test, and adjust engine fuel shut-down devices and controls; determine needed repairs. | P-3 |

**Subunit 2.9: Fuel System Diagnosis and Repair: Electronic Fuel Injection System Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 2.9.1 | Inspect and test power and ground circuits and connections; determine needed repairs. | P-1 |
| 2.9.2 | Check DTC (Diagnostic Trouble Codes) from on-board computer system utilizing scan tool and technical information; determine needed repairs. | P-2 |
| 2.9.3 | Inspect and replace electrical connector terminals, seals, and locks. | P-2 |
| 2.9.4 | Inspect and test sensors, controls, and actuator components and circuits; adjust or replace as needed. | P-2 |
| 2.9.5 | Connect computer programming equipment to vehicle/engine; access and change customer parameters; determine needed repairs. | P-3 |
| 2.9.6 | Remove, inspect, test, and reinstall and adjust electronic injectors; determine needed repairs. | P-2 |
| 2.9.7 | Perform cylinder power balance utilizing electronic scan tool. | P-3 |
| 2.9.8 | Perform engine timing sensor adjustment. | P-3 |
| 2.9.9 | Utilizing scan tool, extract engine monitoring information. | P-2 |
| 2.9.10 | Download and program an Electrical Control Unit utilizing a PC and a scan tool. | P-3 |

**Subunit 2.10: Engine Brakes**

*Competencies:*

| | | |
|---|---|---|
| 2.10.1 | Inspect and adjust engine brakes; determine needed repairs. | P-2 |
| 2.10.2 | Inspect, test, and adjust engine brake control circuits, switches, and solenoids; repair or replace as needed. | P-3 |
| 2.10.3 | Inspect engine brake housing, valves, seals, screens, lines, and fittings; repair or replace as needed. | P-3 |

# Unit 3: Drive Train

## Subunit 3.1: Clutch Diagnosis and Repair

*Competencies:*

| | | |
|---|---|---|
| 3.1.1 | Diagnose clutch noise, binding, slippage, pulsation, grabbing, and chatter problems; determine needed repairs. | P-2 |
| 3.1.2 | Inspect and adjust clutch linkage, cables, levers, brackets, bushings, pivots, and springs (includes push and pull-type assemblies); service or replace as needed. | P-2 |
| 3.1.3 | Inspect, adjust, service and replace hydraulic clutch slave and master cylinders; inspect lines and hoses; bleed system. | P-2 |
| 3.1.4 | Inspect, adjust, service or replace release (throw-out) bearing; inspect and service sleeve, bushing, springs, levers, shafts, and seals. | P-2 |
| 3.1.5 | Inspect and adjust single disc clutch assembly. | P-2 |
| 3.1.6 | Inspect, adjust, measure, align or replace double-disc clutch assembly (includes intermediate plate and drive pins). | P-2 |
| 3.1.7 | Inspect, adjust, or replace clutch brake assembly; inspect input shaft splines. | P-3 |
| 3.1.8 | Inspect self-adjusting clutch mechanisms; determine needed repairs. | P-3 |
| 3.1.9 | Inspect and replace pilot bearing. | P-2 |
| 3.1.10 | Inspect flywheel mounting area on crankshaft; check crankshaft end play; determine needed repairs. | P-2 |
| 3.1.11 | Inspect flywheel and starter ring gear; determine needed repairs. | P-2 |
| 3.1.12 | Measure flywheel face runout and pilot bore runout; determine needed repairs. | P-2 |
| 3.1.13 | Inspect engine block, flywheel housing, and transmission housing mating surfaces; determine needed repairs. | P-2 |
| 3.1.14 | Measure flywheel housing bore runout and face runout; determine needed repairs. | P-3 |

## Subunit 3.2: Transmission Diagnosis and Repair

*Competencies:*

| | | |
|---|---|---|
| 3.2.1 | Diagnose transmission noise, shifting, lockup, jump-out-of-gear, overheating, and vibration problems; determine needed repairs. | P-2 |
| 3.2.2 | Diagnose transmission component failure cause, both before and during disassembly procedures; determine needed repairs. | P-3 |
| 3.2.3 | Inspect, adjust, service, repair, or replace transmission remote shift linkages, brackets, bushings, pivots, and levers. | P-2 |
| 3.2.4 | Inspect, test, adjust, repair, or replace air shift controls, lines, hoses, valves, regulators, filters, and cylinder assemblies. | P-1 |
| 3.2.5 | Inspect and replace transmission mounts, insulators, and mounting bolts; determine needed repairs. | P-2 |

*Continued*

***Subunit 3.2:*** ***Transmission Diagnosis and Repair—Continued***

| | | |
|---|---|---|
| 3.2.6 | Inspect for leakage and replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; determine needed repairs. | P-2 |
| 3.2.7 | Check transmission fluid level, proper type, and condition; determine needed service. | P-1 |
| 3.2.8 | Inspect, adjust, and replace transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detentes, interlocks, springs, and lock bolts. | P-3 |
| 3.2.9 | Remove and reinstall transmission. | P-3 |
| 3.2.10 | Inspect and replace input shaft, gear, spacers, bearings, retainers, and slingers. | P-3 |
| 3.2.11 | Inspect and adjust main shaft, gears, sliding clutches, washers, spacers, bushings, bearings, auxiliary drive assemblies, retainers, and keys; replace as needed. | P-3 |
| 3.2.12 | Inspect countershafts, gears, bearings, retainers, and keys; adjust bearing preload and time multiple countershaft gears; replace as needed. | P-3 |
| 3.2.13 | Inspect output shafts, gears, washers, spacers, bearings, retainers, and keys; replace as needed. | P-3 |
| 3.2.14 | Inspect and replace reverse idler shafts, gears, bushings, bearings, thrust washers, and retainers; check reverse idler gear end play (where applicable). | P-3 |
| 3.2.15 | Inspect and replace synchronizer hub, sleeve, keys (inserts), springs, blocking rings, synchronizer plates, blocker pins, and sliding clutches. | P-3 |
| 3.2.16 | Inspect or replace transmission cases including surfaces, bores, bushings, pins, studs, and magnets; determine needed repairs. | P-3 |
| 3.2.17 | Inspect transmission lubrication system pumps, troughs, collectors, and slingers; service or replace as needed. | P-3 |
| 3.2.18 | Inspect and replace transmission oil filters; inspect coolers. | P-2 |
| 3.2.19 | Inspect speedometer components; determine needed repairs. | P-2 |
| 3.2.20 | Inspect and adjust power take-off (P.T.O.) assemblies, controls, and power take-off (P.T.O.) shafts; service, repair, or replace as needed. | P-3 |
| 3.2.21 | Inspect and test function of backup light, neutral start, and warning device circuit switches; determine needed repairs. | P-2 |
| 3.2.22 | Inspect and test transmission temperature gauge; determine needed repairs. | P-3 |
| 3.2.23 | Inspect and adjust transfer case assemblies; remove and/or replace as needed. | P-3 |

**Subunit 3.3:** **Drive Shaft and Universal Joint Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 3.3.1 | Diagnose driveshaft and universal joint noise and vibration problems; determine needed repairs. | P-2 |
| 3.3.2 | Inspect, service, or replace driveshaft, slip joints, yokes, drive flanges, universal joints; check phasing of all yokes. | P-2 |
| 3.3.3 | Inspect, service, repair, and replace driveshaft center support bearings and mounts. | P-2 |
| 3.3.4 | Measure and adjust drive line angles. | P-2 |

**Subunit 3.4: Drive Axle Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 3.4.1 | Diagnose rear axle(s) drive unit noise and overheating problems; determine needed repairs. | P-2 |
| 3.4.2 | Check for and repair fluid leaks; inspect and replace rear axle(s) drive unit cover plates, gaskets, vents, magnetic plugs, and seals. | P-2 |
| 3.4.3 | Check rear axle(s) drive unit fluid level and condition; determine needed service and add proper type of lubricant. | P-1 |
| 3.4.4 | Remove and replace differential carrier assembly. | P-3 |
| 3.4.5 | Inspect and replace differential case assembly including spider gears, cross shaft, side gears, thrust washers, case halves, and bearings. | P-3 |
| 3.4.6 | Inspect and replace components of traction control (limited slip) differential case assembly. | P-3 |
| 3.4.7 | Inspect differential carrier case and caps, side bearing bores, and pilot bearing bore; determine needed service. | P-3 |
| 3.4.8 | Measure ring gear runout; determine needed repairs. | P-2 |
| 3.4.9 | Inspect and replace ring and drive pinion gears, spacers, sleeves, bearing cage, and bearings. | P-3 |
| 3.4.10 | Measure and adjust drive pinion bearing preload. | P-3 |
| 3.4.11 | Adjust drive pinion depth. | P-3 |
| 3.4.12 | Measure and adjust side bearing preload and ring pinion backlash. | P-3 |
| 3.4.13 | Check and interpret ring and pinion tooth contact pattern; determine needed repairs. | P-2 |
| 3.4.14 | Inspect, adjust, or repair ring gear thrust block/screw. | P-3 |
| 3.4.15 | Inspect, adjust, repair, or replace planetary gear-type 2-speed axle assembly including: case, idler pinion, pins, thrust washers, sliding clutch gear, shift fork, pivot, seals, cover, and springs. | P-3 |
| 3.4.16 | Inspect, repair, or replace 2-speed axle shift control system speedometer adapters, motors, axle shift units, wires, air lines, and connectors. | P-2 |
| 3.4.17 | Inspect power divider (inter-axle differential) assembly; determine needed repairs. | P-3 |
| 3.4.18 | Inspect, adjust, repair, or replace air operated power divider (inter-axle differential) lockout assembly including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls. | P-2 |
| 3.4.19 | Inspect, repair, or replace rear axle lubrication system pump, troughs, collectors, slingers, tubes, and filters. | P-3 |
| 3.4.20 | Inspect and replace rear axle shafts. | P-2 |
| 3.4.21 | Remove and replace wheel assembly; check rear wheel seal and axle flange gasket for leaks; determine needed repairs. | P-2 |
| 3.4.22 | Diagnose rear wheel bearing noises and damage; determine needed repairs. | P-2 |
| 3.4.23 | Inspect and test rear axle temperature gauge sensor; determine needed repairs. | P-3 |

# Unit 4: Suspension and Steering

## Subunit 4.1: Steering Systems Diagnosis and Repair: Steering Column and Manual Steering Gear

*Competencies:*

| | | |
|---|---|---|
| 4.1.1 | Diagnose steering system problems, column and shaft noise, looseness, and binding problems; determine needed repairs. | P-2 |
| 4.1.2 | Inspect steering shaft U-joint(s), slip joints, bearings, bushings, and seals; phase shaft U-joints; replace as needed. | P-2 |
| 4.1.3 | Diagnose manual steering gear noise, binding, uneven turning effort, looseness, hard steering, and lubricant leakage problems; determine needed repairs. | P-3 |
| 4.1.4 | Inspect lubricant for proper type, level, and condition; determine needed service. | P-3 |
| 4.1.5 | Inspect manual steering gear bushings, bearings, shafts, seals, gaskets, and mounting bolts; service, repair or replace as needed. | P-3 |
| 4.1.6 | Adjust manual steering gear worm bearing preload. | P-3 |
| 4.1.7 | Determine center position (high point) of pitman (cross) shaft; adjust sector shaft lash. | P-3 |

## Subunit 4.2: Steering Systems Diagnosis and Repair: Power Steering Systems

*Competencies:*

| | | |
|---|---|---|
| 4.2.1 | Diagnose power steering system problems: noises, steering binding, uneven turning effort, looseness, hard steering, overheating, fluid leakage, and fluid aeration problems; determine needed repairs. | P-1 |
| 4.2.2 | Inspect power steering fluid type, level, and condition; determine needed service. | P-1 |
| 4.2.3 | Purge power steering system. | P-2 |
| 4.2.4 | Perform power steering system pressure and flow tests; determine needed repairs. | P-2 |
| 4.2.5 | Inspect power steering reservoir including filter, seals, and gaskets; service or replace as needed. | P-2 |
| 4.2.6 | Inspect, adjust, and align power steering pump belt(s), pulley(s), and tensioner(s); replace as needed. | P-1 |
| 4.2.7 | Inspect power steering pump drive gear and coupling; replace as needed. | P-3 |
| 4.2.8 | Inspect power steering pump, mountings, and brackets; replace as needed. | P-3 |
| 4.2.9 | Inspect power steering pump pressure regulator valves; replace as needed. | P-3 |
| 4.2.10 | Inspect power steering system cooler, lines, hoses, and fittings; replace as needed. | P-3 |
| 4.2.11 | Inspect and adjust linkage assist-type power steering control and remote relief valves; repair or replace as needed. | P-3 |
| 4.2.12 | Inspect and adjust linkage assist-type power steering cylinder; replace as needed. | P-3 |
| 4.2.13 | Inspect and adjust integral-type power steering gear, worm gear preload and sector shaft; inspect and adjust poppet valves; repair or replace as needed. | P-1 |
| 4.2.14 | Inspect and adjust dual power steering gear systems; replace as needed. | P-3 |
| 4.2.15 | Inspect power steering gear, seals, and gaskets; replace as needed. | P-2 |

**Subunit 4.3: Steering Systems Diagnosis and Repair: Steering Linkage**

*Competencies:*

| | | |
|---|---|---|
| 4.3.1 | Inspect pitman arm; replace as needed. | P-2 |
| 4.3.2 | Inspect and adjust drag link and tie rod; replace as needed. | P-2 |
| 4.3.3 | Inspect and adjust drag link and tie rod ends (ball and socket type); replace as needed. | P-2 |
| 4.3.4 | Inspect steering arm and levers and linkage pivot joints; replace as needed. | P-1 |
| 4.3.5 | Inspect and position as needed, clamps and retainers; replace as needed. | P-1 |
| 4.3.6 | Check steering linkage or wheel stops; adjust as needed. | P-1 |

**Subunit 4.4: Suspension Systems Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 4.4.1 | Diagnose ride problems. | P-2 |
| 4.4.2 | Inspect front axles, U-bolts, and nuts; determine needed repairs. | P-1 |
| 4.4.3 | Inspect and service king pin, steering knuckle bushings, locks, bearings, seals, and covers; determine needed repairs. | P-1 |
| 4.4.4 | Inspect shock absorbers, bushings, brackets, and mounts; replace as needed. | P-2 |
| 4.4.5 | Inspect leaf springs, center bolts, clips, eye bolts and bushings, shackles, slippers, insulators, brackets, and mounts; determine needed service and repairs. | P-1 |
| 4.4.6 | Inspect torsion bars, bell cranks, ratchets, bushings, bearings, and mounting brackets; determine needed service and repairs. | P-3 |
| 4.4.7 | Inspect torque arms, bushings, and mounts; determine needed repairs. | P-2 |
| 4.4.8 | Inspect axle aligning devices such as radius rods, track bars, stabilizer bars, and bushings, mounts, shims, and cams; determine needed repairs. | P-2 |
| 4.4.9 | Inspect walking beams, center (cross) tube, bushings, mounts, load pads, and saddles/caps; replace as needed. | P-3 |
| 4.4.10 | Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; adjust, repair or replace as needed. | P-2 |
| 4.4.11 | Inspect and test air springs, mounting plates, springs, suspension arms, and bushings; replace as needed. | P-2 |
| 4.4.12 | Measure vehicle frame angle (ride height); determine needed repairs. | P-2 |

**Subunit 4.5: Wheel Alignment Diagnosis, Adjustment, and Repair**

*Competencies:*

| | | |
|---|---|---|
| 4.5.1 | Diagnose vehicle wandering, pulling, shimmy, and hard steering problem(s); adjust and repair as needed. | P-2 |
| 4.5.2 | Check camber and KPI (king pin inclination); determine needed repairs. | P-2 |
| 4.5.3 | Check caster; adjust or repair as needed. | P-2 |
| 4.5.4 | Check toe; adjust as needed. | P-1 |
| 4.5.5 | Check rear axle(s) alignment (thrustline/centerline) and tracking; adjust or repair as needed. | P-2 |
| 4.5.6 | Diagnose turning/Ackerman angle (toe-out-on-turns) problems; determine needed repairs. | P-3 |

**Subunit 4.6: Wheels and Tires Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 4.6.1 | Diagnose unusual tire wear patterns; determine needed repairs. | P-1 |
| 4.6.2 | Diagnose wheel/tire vibration, shimmy, pounding, hop (tramp) problems; determine needed repairs. | P-2 |
| 4.6.3 | Inspect wheels, rims, spacers, clamps, studs, and nuts; replace as needed. | P-1 |
| 4.6.4 | Inspect tire and wheel assemblies in accordance with manufacturers' recommended procedures. | P-2 |
| 4.6.5 | Measure wheel and tire radial and lateral runout; adjust or repair as needed. | P-2 |
| 4.6.6 | Inspect tires; check air pressure. | P-1 |
| 4.6.7 | Perform static balance of wheel and tire assembly. | P-3 |
| 4.6.8 | Perform dynamic balance of wheel and tire assembly. | P-3 |
| 4.6.9 | Measure tire diameter; match tires on tandem axle(s). | P-1 |
| 4.6.10 | Clean, inspect, lubricate, and adjust wheel bearings; replace seals and wear rings; replace as needed. | P-1 |

**Subunit 4.7: Wheels and Tires Diagnosis and Repair: Related Components**

*Competencies:*

| | | |
|---|---|---|
| 4.7.1 | Inspect and service fifth wheel assemblies and pintle hitch; determine needed repairs. | P-2 |
| 4.7.2 | Inspect frame and frame members for cracks, breaks, distortion (alignment), elongated holes, looseness, and damage; determine needed repairs. | P-2 |
| 4.7.3 | Inspect, install, or repair frame, hangers, brackets, and crossmembers. | P-3 |
| 4.7.4 | Inspect, test, and adjust cab air suspension components: lines, hoses, fittings, air springs, bushings, shocks, valves, and linkage; determine needed repairs. | P-2 |
| 4.7.5 | Inspect, test, and adjust driver's air seat components; determine needed repairs. | P-3 |
| 4.7.6 | Check thrust angle (tracking) | P-3 |
| 4.7.7 | Inspect fifth wheel plate and pin (trailer) | P-3 |

# Unit 5: Brakes

## Subunit 5.1: Air Brakes Diagnosis and Repair: Air Supply and Service Systems

*Competencies:*

| | | |
|---|---|---|
| 5.1.1 | Diagnose poor stopping, air leaks, pulling, grabbing, or dragging problems caused by supply and service system malfunctions; determine needed repairs. | P-2 |
| 5.1.2 | Check air system build-up time; determine needed repairs. | P-1 |
| 5.1.3 | Drain air reservoir tanks; check for oil, water, and foreign material; determine needed repairs. | P-1 |
| 5.1.4 | Inspect, adjust, and align compressor drive belts, pulleys, and tensioners; replace as needed. | P-2 |
| 5.1.5 | Inspect and time compressor drive gear and coupling; replace as needed. | P-3 |
| 5.1.6 | Inspect air compressor, air cleaner/supply, and oil and water lines and fittings; repair or replace as needed. | P-2 |
| 5.1.7 | Inspect, test, and adjust system pressure controls (governor/relief valve), unloader assembly valves, filters, lines, hoses, and fittings; replace as needed. | P-2 |
| 5.1.8 | Inspect air system lines, hoses, fittings, and couplings; repair or replace as needed. | P-2 |
| 5.1.9 | Inspect, test, and clean air tank relief (pop-off) valves, one-way check valves, drain cocks, spitter valves, heaters, wiring, and connectors; replace as needed. | P-2 |
| 5.1.10 | Inspect and clean air drier systems, filters, valves, heaters, wiring, and connectors; repair or replace as needed. | P-2 |
| 5.1.11 | Inspect and test brake application (foot) valve, fittings, and mounts; adjust or replace as needed. | P-2 |
| 5.1.12 | Inspect, test, and clean two-way check valves; replace as needed. | P-2 |
| 5.1.13 | Inspect and test stop and parking brake light circuit switches, wiring, and connectors; repair or replace as needed. | P-3 |
| 5.1.14 | Inspect and test hand brake (trailer) control valve, lines, fittings, and mountings; repair or replace as needed. | P-2 |
| 5.1.15 | Inspect and test brake relay valve; replace as needed. | P-2 |
| 5.1.16 | Inspect and test quick release valves; replace as needed. | P-2 |
| 5.1.17 | Inspect and test front and rear axle limiting (proportioning) valves; replace as needed. | P-2 |
| 5.1.18 | Inspect and test tractor protection valve; replace as needed. | P-2 |
| 5.1.19 | Inspect and test emergency (spring) brake control valve(s) and inversion valve; replace as needed. | P-1 |
| 5.1.20 | Inspect and test low pressure warning devices, wiring, and connectors; replace as needed. | P-1 |
| 5.1.21 | Inspect and test air pressure gauges, lines, and fittings; replace as needed. | P-3 |

**Subunit 5.2: Air Brakes Diagnosis and Repair: Mechanical/Foundation**

*Competencies:*

| | | |
|---|---|---|
| 5.2.1 | Diagnose poor stopping, brake noise, pulling, grabbing, or dragging complaints caused by foundation brake, slack adjuster, and brake chamber problems; determine needed repairs. | P-2 |
| 5.2.2 | Inspect, test, adjust, and service brake chambers, diaphragm, clamp, spring, pushrod, clevis, and mounting brackets; repair or replace as needed. | P-2 |
| 5.2.3 | Inspect and service manual and automatic slack adjusters; adjust or replace as needed. | P-2 |
| 5.2.4 | Inspect cams, rollers, shafts, bushings, seals, spacers, and retainers; service or replace as needed. | P-2 |
| 5.2.5 | Inspect brake spider, shields, anchor pins, bushings, and springs; service or replace as needed. | P-2 |
| 5.2.6 | Inspect wedge brake spider, manual and automatic adjuster plungers, housing, and wedge assembly; repair or replace as needed. | P-3 |
| 5.2.7 | Inspect, clean, and adjust air disc brake caliper assemblies; determine needed repairs. | P-3 |
| 5.2.8 | Inspect brake shoes or pads; replace as needed. | P-2 |
| 5.2.9 | Inspect and measure brake drums or rotors; determine needed repairs. | P-2 |

**Subunit 5.3: Air Brakes Diagnosis and Repair: Parking Brakes**

*Competencies:*

| | | |
|---|---|---|
| 5.3.1 | Inspect drive line parking brake drums, rotors, bands, shoes, mounting hardware, and adjusters; adjust, repair, or replace as needed. | P-2 |
| 5.3.2 | Inspect drive line parking brake application system pedal, cables, linkage, levers, pivots, and springs; adjust, repair, or replace as needed. | P-2 |
| 5.3.3 | Check operation of parking (spring) brake chamber; determine needed repairs. | P-2 |
| 5.3.4 | Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; replace as needed. | P-2 |
| 5.3.5 | Inspect and test parking (spring) brake application and release valve; replace as needed. | P-2 |
| 5.3.6 | Manually release and reset parking (spring) brakes in accordance with manufacturers' recommendations. | P-2 |

**Subunit 5.4: Air Brakes Diagnosis and Repair: Anti-lock Brake Systems**

*Competencies:*

| | | |
|---|---|---|
| 5.4.1 | Inspect, test, and service anti-lock brake system (ABS) air, electrical/electronic, and mechanical components. | P-2 |
| 5.4.2 | Diagnose poor stopping, wheel lock-up, pulsation, and noise problems caused by the anti-lock brake system (ABS); determine needed repairs. | P-2 |
| 5.4.3 | Observe anti-lock brake system (ABS) warning light at startup; determine if further diagnosis is needed. | P-2 |
| 5.4.4 | Diagnose anti-lock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine needed repairs. | P-2 |
| 5.4.5 | Service, test, and adjust anti-lock brake system (ABS) speed sensors following manufacturer's recommended procedures. | P-2 |

**Subunit 5.5: Hydraulic Brakes Diagnosis and Repair: Hydraulic System**

*Competencies:*

| | | |
|---|---|---|
| 5.5.1 | Diagnose poor stopping, pulling, or dragging problems caused by the hydraulic system; determine needed repairs. | P-2 |
| 5.5.2 | Test hydraulic system; inspect for leaks. | P-2 |
| 5.5.3 | Check and adjust brake pedal pushrod length. | P-3 |
| 5.5.4 | Inspect and test master cylinder; determine needed repairs. | P-2 |
| 5.5.5 | Inspect, test, or replace brake lines, flexible hoses, and fittings. | P-2 |
| 5.5.6 | Inspect and test metering (hold-off), proportioning, and combination valves; replace as needed. | P-2 |
| 5.5.7 | Inspect and test brake pressure differential valve and warning light circuit switch, bulbs, wiring, and connectors; repair or replace as needed. | P-1 |
| 5.5.8 | Inspect wheel cylinders; determine needed repairs. | P-2 |
| 5.5.9 | Inspect disc brake caliper assemblies; determine needed repairs. | P-2 |
| 5.5.10 | Bleed and/or flush hydraulic system. | P-1 |
| 5.5.11 | Inspect and test hydraulic parking brake systems; repair or replace as needed. | P-3 |

**Subunit 5.6: Hydraulic Brakes Diagnosis and Repair: Mechanical System**

*Competencies:*

| | | |
|---|---|---|
| 5.6.1 | Diagnose poor stopping, noise, pulling, grabbing, dragging, or pedal pulsation problems caused by drum and disc brake mechanical assembly; determine needed repairs. | P-2 |
| 5.6.2 | Inspect and measure brake drums or rotors; determine needed repairs. | P-2 |
| 5.6.3 | Inspect drum brake shoes, mounting hardware, adjuster mechanisms, and backing plates; replace as needed. | P-2 |
| 5.6.4 | Inspect disc brake pads and mounting hardware; replace as needed. | P-2 |

**Subunit 5.7: Hydraulic Brakes Diagnosis and Repair: Power Assist Units and Related Components**

*Competencies:*

| | | |
|---|---|---|
| 5.7.1 | Diagnose poor stopping problems caused by power brake booster(s); determine needed repairs. | P-2 |
| 5.7.2 | Inspect and test power brake booster(s), hoses, and control valves; replace as needed. | P-2 |
| 5.7.3 | Test and adjust brake stop light switch, bulbs, wiring, and connectors; repair or replace as needed. | P-2 |
| 5.7.4 | Check emergency (stand-by) hydraulic boost system. | P-2 |

**Subunit 5.8: Hydraulic Brakes Diagnosis and Repair: Anti-lock Brake Systems**

*Competencies:*

| | | |
|---|---|---|
| 5.8.1 | Inspect, test, and service anti-lock brake system (ABS) air, electrical/electronic, and mechanical components. | P-2 |
| 5.8.2 | Diagnose poor stopping, wheel lock-up, pulsation, and noise problems caused by the anti-lock brake system (ABS); determine needed repairs. | P-2 |
| 5.8.3 | Observe anti-lock brake system (ABS) warning light at startup; determine if further diagnosis is needed. | P-2 |
| 5.8.4 | Diagnose anti-lock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine needed repairs. | P-2 |
| 5.8.5 | Service, test, and adjust anti-lock brake system (ABS) speed sensors following manufacturer's recommended procedures. | P-2 |

# Unit 6: Electrical/Electronic Systems

**Subunit 6.1: General Electrical Systems Diagnosis**

*Competencies:*

| | | |
|---|---|---|
| 6.1.1 | Check continuity in electrical/electronic circuits using appropriate test equipment and wiring diagrams. | P-1 |
| 6.1.2 | Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using a digital multimeter (DMM). | P-1 |
| 6.1.3 | Check current flow in electrical/electronic circuits and components using an ammeter. | P-1 |
| 6.1.4 | Check resistance in electrical/electronic circuits and components using an ohmmeter. | P-1 |
| 6.1.5 | Find shorts, grounds, and opens in electrical/electronic circuits. | P-1 |
| 6.1.6 | Diagnose key-off battery drain problems. | P-1 |
| 6.1.7 | Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed. | P-2 |
| 6.1.8 | Inspect and test spike suppression diodes/resistors; replace as needed. | P-3 |

**Subunit 6.2: Battery Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 6.2.1 | Perform battery hydrometer test; determine specific gravity of each cell. | P-3 |
| 6.2.2 | Perform battery capacity (load, high rate discharge) test; determine needed service. | P-1 |
| 6.2.3 | Determine battery state of charge by measuring terminal post voltage using a DMM. | P-2 |
| 6.2.4 | Inspect, clean, and service battery; replace as needed. | P-2 |
| 6.2.5 | Inspect and clean battery boxes, mounts, and hold downs; repair or replace as needed. | P-2 |
| 6.2.6 | Charge battery using slow or fast charge method as appropriate. | P-2 |
| 6.2.7 | Inspect and clean battery cables and connectors; repair or replace as needed. | P-2 |
| 6.2.8 | Jump start a vehicle using jumper cables and a booster battery or auxiliary power supply using proper safety procedures. | P-2 |

**Subunit 6.3: Starting System Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 6.3.1 | Perform starter current draw test; determine needed repairs. | P-1 |
| 6.3.2 | Perform starter circuit voltage drop tests; determine needed repairs. | P-1 |
| 6.3.3 | Inspect, test, and replace components and wires in the starter control circuit. | P-2 |
| 6.3.4 | Remove and replace starter. | P-3 |
| 6.3.5 | Inspect, test, and replace starter relays and solenoids/switches. | P-2 |

**Subunit 6.4: Charging System Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 6.4.1 | Diagnose dash mounted charge meters and/or indicator lights that show a no charge, low charge, or overcharge condition; determine needed repairs. | P-2 |
| 6.4.2 | Diagnose the cause of a no charge, low charge, or overcharge condition; determine needed repairs. | P-1 |
| 6.4.3 | Inspect, adjust, and replace alternator drive belts, pulleys, fans, and mounting brackets. | P-1 |
| 6.4.4 | Inspect and replace alternator drive gears and couplings. | P-3 |
| 6.4.5 | Perform charging system output test; determine needed repairs. | P-1 |
| 6.4.6 | Perform charging circuit voltage drop tests; determine needed repairs. | P-1 |
| 6.4.7 | Remove and replace alternator. | P-3 |
| 6.4.8 | Inspect, repair, or replace connectors and wires in the charging circuit. | P-2 |
| 6.4.9 | Diagnose 12/24 volt alternator charging system problems; determine needed repairs. | P-3 |

**Subunit 6.5: Lighting Systems Diagnosis and Repair: Headlights, Parking, Clearance, Tail, Cab, and Dash Lights**

*Competencies:*

| | | |
|---|---|---|
| 6.5.1 | Diagnose the cause of brighter than normal, intermittent, dim, or no headlight operation. | P-2 |
| 6.5.2 | Test, aim, and replace headlights. | P-2 |
| 6.5.3 | Test headlight and dimmer switches and relays, wires, terminals, connectors, and sockets; repair or replace as needed. | P-2 |
| 6.5.4 | Inspect and test switches, bulbs, sockets, connectors, terminals, and wires of parking, clearance, and taillight circuits; repair or replace as needed. | P-2 |
| 6.5.5 | Inspect and test dash light circuit switches and relays, bulbs, sockets, connectors, terminals, wires, and printed circuits/control modules; repair or replace as needed. | P-2 |
| 6.5.6 | Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals, and wires; repair or replace as needed. | P-2 |
| 6.5.7 | Inspect and test tractor to trailer multi-wire connector; repair or replace as needed. | P-2 |

**Subunit 6.6: Lighting Systems Diagnosis and Repair: Stoplights, Turn Signals, Hazard Lights, and Back-up Lights**

*Competencies:*

| | | |
|---|---|---|
| 6.6.1 | Inspect, test, and adjust stoplight circuit switches, bulbs, sockets, connectors, terminals, and wires; repair or replace as needed. | P-2 |
| 6.6.2 | Diagnose the cause of turn signal and hazard flasher lights problems. | P-2 |
| 6.6.3 | Inspect and test turn signal and hazard circuit flasher, switches, relays, bulbs, sockets, connectors, terminals, and wires; repair or replace as needed. | P-2 |
| 6.6.4 | Inspect, test, and adjust back-up light and warning device circuit switches, bulbs, sockets, horns, buzzers, connectors, terminals, and wires; repair or replace as needed. | P-2 |

**Subunit 6.7: Gauges and Warning Devices Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 6.7.1 | Diagnose the cause of intermittent, high, low, or no gauge readings; determine needed repairs. | P-2 |
| 6.7.2 | Test and replace gauge-circuit voltage regulators (limiters). | P-3 |
| 6.7.3 | Inspect, test, and adjust gauge circuit sending units, gauges, connectors, terminals, and wires; repair or replace as needed. | P-2 |
| 6.7.4 | Inspect and test warning light circuit sending units, bulbs, sockets, connectors, wires, and printed circuits/control modules; repair or replace as needed. | P-2 |
| 6.7.5 | Inspect and test warning buzzer circuit sending units, buzzers, switches, relays, connectors, terminals, wires, and printed circuits/control modules; repair or replace as needed. | P-2 |
| 6.7.6 | Inspect, test, replace, and calibrate electronic speedometer, odometer, and tachometer systems. | P-2 |

**Subunit 6.8: Gauges and Warning Devices Diagnosis and Repair: Related Electrical Components**

*Competencies:*

| | | |
|---|---|---|
| 6.8.1 | Diagnose the cause of constant, intermittent, or no horn operation. | P-2 |
| 6.8.2 | Inspect and test horn circuit relays, horns, switches, connectors, and wires; repair or replace as needed. | P-2 |
| 6.8.3 | Diagnose the cause of constant, intermittent, or no wiper operation; diagnose the cause of wiper speed control and/or park problems. | P-2 |
| 6.8.4 | Inspect and test wiper motor, resistors, park switch, relays, switches, connectors, and wires; repair or replace as needed. | P-2 |
| 6.8.5 | Inspect and replace wiper motor transmission linkage, arms, and blades. | P-2 |
| 6.8.6 | Inspect and test windshield washer motor or pump/relay assembly, switches, connectors, terminals, and wires; repair or replace as needed. | P-3 |
| 6.8.7 | Inspect and test mirror; heater circuit grids, motors, relays, switches, connectors, and wires; repair or replace as needed. | P-3 |
| 6.8.8 | Inspect and test heater and A/C electrical components including: A/C clutch motors, resistors, relays, switches, connectors, terminals, and wires; repair or replace as needed. | P-3 |
| 6.8.9 | Inspect and test cigarette lighter case, integral fuse, connectors, terminals, and wires; repair or replace as needed. | P-3 |
| 6.8.10 | Diagnose the cause of slow, intermittent, or no power side window operation. | P-3 |
| 6.8.11 | Inspect and test motors, switches, relays, connectors, terminals, and wires of power side window circuits; repair or replace as needed. | P-3 |
| 6.8.12 | Inspect block heaters; determine needed repairs. | P-2 |

# Unit 7: Heating and Air Conditioning

NOTE: All practices and procedures must be performed according to current mandates, standards, and regulations.

**Subunit 7.1: A/C System Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 7.1.1 | Diagnose the cause of unusual operating noises of the A/C system; determine needed repairs. | P-2 |
| 7.1.2 | Identify system type and conduct performance test of the A/C system; determine needed repairs. | P-1 |
| 7.1.3 | Diagnose A/C system problems indicated by refrigerant flow past the sight glass (for systems using a sight glass); determine needed repairs. | P-2 |
| 7.1.4 | Diagnose A/C system problems indicated by pressure gauge readings; determine needed repairs. | P-1 |

*Continued*

***Subunit 7.1:*** ***A/C System Diagnosis and Repair—Continued***

| | | |
|---|---|---|
| 7.1.5 | Diagnose A/C system problems indicated by visual and touch procedures; determine needed repairs. | P-2 |
| 7.1.6 | Leak test A/C system; determine needed repairs. | P-1 |
| 7.1.7 | Evacuate A/C system. | P-1 |
| 7.1.8 | Clean A/C system components and hoses in accordance with required procedures. | P-2 |
| 7.1.9 | Charge A/C system with required refrigerant (liquid or vapor). | P-2 |

**Subunit 7.2:** **Refrigeration System Component Diagnosis and Repair: Compressor and Clutch**

*Competencies:*

| | | |
|---|---|---|
| 7.2.1 | Diagnose A/C system problems that cause the pressure protection devices to interrupt system operation; determine needed repairs. | P-2 |
| 7.2.2 | Inspect A/C system pressure protection devices (including engine fan controls); determine needed repairs. | P-2 |
| 7.2.3 | Inspect and adjust A/C compressor drive belts and pulleys; determine needed repairs. | P-1 |
| 7.2.4 | Inspect and test A/C compressor clutch components or assembly; replace as needed. | P-2 |
| 7.2.5 | Inspect and adjust oil level in A/C compressor. | P-2 |
| 7.2.6 | Inspect and test A/C compressor; replace as needed. | P-3 |
| 7.2.7 | Inspect A/C compressor mountings; repair or replace as needed. | P-3 |

**Subunit 7.3:** **Refrigeration System Component Diagnosis and Repair: Evaporator, Condenser, and Related Components**

*Competencies:*

| | | |
|---|---|---|
| 7.3.1 | Inspect A/C system mufflers, hoses, lines, filters, fittings, and seals; repair or replace as needed. | P-2 |
| 7.3.2 | Inspect A/C condenser for air flow restrictions; clean and straighten fins. | P-2 |
| 7.3.3 | Inspect, test, and replace A/C system condenser and mountings. | P-3 |
| 7.3.4 | Inspect receiver/drier; replace as needed. | P-2 |
| 7.3.5 | Inspect accumulator/drier in orifice tube A/C systems; replace as needed. | P-2 |
| 7.3.6 | Inspect and test expansion valve; replace as needed. | P-2 |
| 7.3.7 | Inspect and test orifice tube (including filter); replace as needed. | P-2 |
| 7.3.8 | Inspect, test, and clean evaporator; replace as needed. | P-3 |
| 7.3.9 | Inspect and clean evaporator housing and water drain; repair as needed. | P-3 |
| 7.3.10 | Identify and inspect A/C system service valves (gauge connections); replace as needed. | P-2 |
| 7.3.11 | Inspect A/C system high pressure relief device; replace as needed. | P-3 |

**Subunit 7.4: Heating System Diagnosis and Repair**

*Competencies:*

| | | |
|---|---|---|
| 7.4.1 | Diagnose the cause of temperature control problems in the heater/ventilation/air conditioning system; determine needed repairs. | P-2 |
| 7.4.2 | Diagnose window fogging problems; determine needed repairs. | P-3 |
| 7.4.3 | Perform cooling system tests; determine needed repairs. | P-3 |
| 7.4.4 | Inspect and replace heater system hoses; assure correct routing. | P-3 |
| 7.4.5 | Inspect, test, and replace thermostat, by-pass, and housing. | P-3 |
| 7.4.6 | Inspect and test heater coolant control valve (manual, vacuum, air, or electrical types); replace as needed. | P-2 |
| 7.4.7 | Inspect and flush heater core; replace as needed. | P-3 |

**Subunit 7.5: Operating Systems and Related Controls Diagnosis and Repair: Electrical**

*Competencies:*

| | | |
|---|---|---|
| 7.5.1 | Diagnose the electrical and electronic control system of heating, ventilating, and A/C systems; determine needed repairs. | P-2 |
| 7.5.2 | Inspect, test, repair, and replace A/C-heater blower motors, resistors, switches, relay/modules, wiring, and protection devices. | P-2 |
| 7.5.3 | Inspect, test, repair, and replace A/C compressor clutch control devices (relay/ modules, wiring, sensors, switches, diodes, and protection devices). | P-2 |

**Subunit 7.6: Operating Systems and Related Controls Diagnosis and Repair: Vacuum/Mechanical/Air**

*Competencies:*

| | | |
|---|---|---|
| 7.6.1 | Diagnose the controls of the heating, ventilating, and A/C systems; determine needed repairs. | P-3 |
| 7.6.2 | Inspect, test, and service heating, ventilating, and A/C control panel assemblies; replace as needed. | P-3 |
| 7.6.3 | Inspect, test, and adjust heating, ventilating, and A/C control cables and linkages; replace as needed. | P-3 |
| 7.6.4 | Inspect, test, and adjust heating, ventilating, and A/C ducts, doors, hoses, and outlets; repair or replace as needed. | P-3 |
| 7.6.5 | Diagnose temperature control system problems; determine needed repairs. | P-3 |
| 7.6.6 | Diagnose blower system problems; determine needed repairs. | P-2 |
| 7.6.7 | Diagnose air distribution system problems; determine needed repairs. | P-3 |
| 7.6.8 | Inspect, test, and adjust climate control temperature sensor systems; replace as needed. | P-3 |
| 7.6.9 | Inspect and test heater valve and controls; replace as needed. | P-2 |
| 7.6.10 | Inspect and test electric, vacuum, or air motors, solenoids, and switches; replace as needed. | P-3 |

**Subunit 7.7: Refrigerant Recovery, Recycling, and Handling**

*Competencies:*

| | | |
|---|---|---|
| 7.7.1 | Verify correct operation of refrigerant handling equipment. | P-1 |
| 7.7.2 | Identify and recover A/C system refrigerant. | P-1 |
| 7.7.3 | Recycle refrigerant. | P-1 |
| 7.7.4 | Label and store refrigerant. | P-1 |
| 7.7.5 | Test recycled refrigerant for non-condensable gases. | P-1 |

# Unit 8: Preventive Maintenance Inspection

NOTE: The tasks included in the Preventive Maintenance Inspection area are entry-level technician inspection tasks designed to introduce the student to correct procedures and practices of vehicle inspection in a teaching/learning environment. They are not intended to satisfy the Annual Federal Vehicle Inspection requirement as prescribed in the *Federal Motor Carrier Safety Regulations, Part 396, Appendix G to Subchapter B, Minimum Periodic Inspection Standards*. The first task in Preventive Maintenance is to listen to and verify operator's complaints, review past maintenance documents, and determine needed repairs.

**Subunit 8.1: Cab and Body**

*Competencies:*

| | | |
|---|---|---|
| 8.1.1 | Inspect gauges and indicators for proper operation. | P-1 |
| 8.1.2 | Check DOT safety equipment for availability and condition. | P-1 |
| 8.1.3 | Check accessories for proper operation. | P-1 |
| 8.1.4 | Check condition of interior components including seats and upholstery; check operation. | P-1 |
| 8.1.5 | Make visual inspection of cab exterior and body for damage or missing components. | P-1 |
| 8.1.6 | Check air pressure drop. | P-1 |
| 8.1.7 | Compare air pressure build-up time with original equipment specifications. | P-1 |
| 8.1.8 | Check steering wheel free-play. | P-1 |
| 8.1.9 | Check pedal and accelerator operation. | P-1 |

**Subunit 8.2: Tires and Wheels**

*Competencies:*

| | | |
|---|---|---|
| 8.2.1 | Inspect tires for wear patterns, condition, and air pressure; record tread depth. | P-1 |
| 8.2.2 | Check rim/wheel condition (bends, cracks). | P-1 |
| 8.2.3 | Check spacers, clamps, rings, studs, and nuts for cracks, damage, and indications of looseness. | P-1 |
| 8.2.4 | Inspect wheel lug nuts for rust, elongation, or wear indicators that would indicate improper torque. | P-1 |
| 8.2.5 | Inspect outer hubs for oil leaks. | P-1 |
| 8.2.6 | Check wheel bearings for free-play. | P-1 |

**Subunit 8.3: Engine Compartment**

*Competencies:*

| | | |
|---|---|---|
| 8.3.1 | Inspect fluid reservoirs for correct levels and condition. | P-1 |
| 8.3.2 | Check compartment for leaks (fuel, air, coolant, exhaust). | P-1 |
| 8.3.3 | Check alternator, air-conditioning compressor, starter, engine, and air compressor mounts for tightness and wear. | P-1 |
| 8.3.4 | Check hoses and lines (air, water, fuel, power steering, air-conditioning) for wear and tightness. | P-1 |
| 8.3.5 | Check belts for tightness and wear. | P-1 |
| 8.3.6 | Check electrical wiring, routing, and hold-down clamps. | P-1 |
| 8.3.7 | Inspect air intake system (mounts, hoses, clamps, restriction indicators, turbo) for leaks, damage, and restrictions. | P-1 |
| 8.3.8 | Listen and note unusual noises. | P-1 |
| 8.3.9 | Check optional equipment for proper operation. | P-1 |
| 8.3.10 | Check air-conditioning condenser, radiator, and after-coolers for air flow restriction. | P-1 |

**Subunit 8.4: Electrical/Electronic**

*Competencies:*

| | | |
|---|---|---|
| 8.4.1 | Inspect condition of batteries, battery boxes, mountings, and hold-downs. | P-1 |
| 8.4.2 | Inspect condition of battery cables, ends, looms, relays, solenoids, starter wiring, and ground connections. | P-1 |
| 8.4.3 | Check starter and solenoid for proper operation and mounting. | P-1 |
| 8.4.4 | Check condition and operation of charging system including: alternator, mounting brackets, wiring, and belt condition, tension, and alignment. | P-1 |
| 8.4.5 | Check truck and trailer lighting systems for operation, mounting, and condition. | P-1 |
| 8.4.6 | Check operation of dash gauges, dash lights, cab interior lights, wipers, blower fans, turn signals, flashers, air-conditioning, horn, radio, and optional equipment. | P-1 |
| 8.4.7 | Check diagnostic displays for proper operation. | P-1 |

**Subunit 8.5: Chassis/Undercarriage**

*Competencies:*

| | | |
|---|---|---|
| 8.5.1 | Check manual/power steering system and linkage for noises, looseness, binding, hard steering, and fluid leakage. | P-1 |
| 8.5.2 | Inspect front and rear axles and suspension components for wear and damage. | P-1 |
| 8.5.3 | Check clutch adjustment. | P-1 |
| 8.5.4 | Inspect clutch linkage for looseness or binding. | P-1 |
| 8.5.5 | Inspect leaf springs, U-bolts, nuts, bushings, shackles, and mounts for looseness and damage. | P-1 |

*Continued*

***Subunit 8.5:*** ***Chassis/Undercarriage****—Continued*

| | | |
|---|---|---|
| 8.5.6 | Inspect air springs, mounts, hoses, and fittings for leaks and damage. | P-1 |
| 8.5.7 | Check mounts; check transmission for leaks and correct fluid levels. | P-1 |
| 8.5.8 | Inspect transmission shift components for leaks and damage. | P-1 |
| 8.5.9 | Inspect driveshaft and yokes for alignment (phasing), wear, and damage. | P-1 |
| 8.5.10 | Inspect brake system air tanks, lines, fittings, valves, brake chambers, and slack adjusters for leaks, damage, and looseness; check mounts. | P-1 |
| 8.5.11 | Inspect fifth wheel assembly for condition, mounting, and proper operation. | P-1 |
| 8.5.12 | Check brake adjustment. | P-1 |
| 8.5.13 | Check brake lining condition, wheel seals, drums, and rotors for wear and damage. | P-1 |

## Supplementary Ohio-Verified Tasks

# Unit 9: Basic Shop and Safety Practices

**Competency 9.1:** **Utilize personal safety equipment** P-1

*Competency Builders:*

| | |
|---|---|
| 9.1.1 | Wear eye and ear protection in accordance with Occupational Safety and Health Administration (OSHA) standards |
| 9.1.2 | Wear prescribed foot and hand protection |
| 9.1.3 | Wear clothing in accordance with OSHA standards |
| 9.1.4 | Remove jewelry in accordance with shop policy |
| 9.1.5 | Secure long hair |
| 9.1.6 | Practice established lifting techniques |
| 9.1.7 | Maintain personal protective equipment |

**Competency 9.2:** **Respond to fire situations** P-1

*Competency Builders:*

| | |
|---|---|
| 9.2.1 | Locate fire exits and alarms |
| 9.2.2 | Follow established evacuation procedures |
| 9.2.3 | Locate fire blankets and first-aid kits |
| 9.2.4 | Identify types of fires and methods appropriate for extinguishing each type |
| 9.2.5 | Demonstrate use of fire extinguishers in accordance with established procedures |
| 9.2.6 | Check operability of fire extinguishers in accordance with established procedures |
| 9.2.7 | Follow established reporting procedures |

**Competency 9.3: Demonstrate general safety practices** P-1

*Competency Builders:*

9.3.1 Interpret shop safety policies and procedures
9.3.2 Comply with shop safety plan
9.3.3 Respond to emergencies and injuries in accordance with established procedures and policies
9.3.4 Report injuries to supervisor
9.3.5 Complete written safety and injury reports
9.3.6 Practice established safety procedures for jacking, lifting, moving, and blocking vehicles and shop equipment (e.g., follow capacity ratings for safety stands)
9.3.7 Practice established safety procedures for short-term vehicle movement
9.3.8 Practice established safety procedures for using chains and straps
9.3.9 Maintain hand tools in safe operating condition
9.3.10 Maintain shop equipment in safe operating condition in accordance with manufacturers'/OSHA specifications
9.3.11 Comply with lock-out/tag-out procedures for defective equipment
9.3.12 Identify offenses that could result in unsafe working conditions leading to disciplinary actions (e.g., horseplay, substance abuse, theft)

**Competency 9.4: Maintain safe work environment** P-1

*Competency Builders:*

9.4.1 Maintain clean work environment
9.4.2 Follow Environmental Protection Agency (EPA) regulations for hazardous materials (e.g., storage, handling, transporting, disposal)
9.4.3 Establish liability associated with hazardous materials
9.4.4 Respond to hazardous chemical spills
9.4.5 Report unsafe practices and conditions
9.4.6 Correct unsafe practices and conditions
9.4.7 Comply with OSHA Right-to-Know law
9.4.8 Apply knowledge of material safety data sheets (MSDSs)

**Competency 9.5: Access needed information using available references and resources** P-2

*Competency Builders:*

9.5.1 Identify available resources (e.g., manufacturers' specifications, toll-free numbers, videos, computer programs, online information systems, service bulletins, service manuals, parts manuals)
9.5.2 Identify reference materials and resources appropriate for given task
9.5.3 Locate needed information within given references and resources
9.5.4 Interpret reference materials and resources

**Competency 9.6: Apply communication skills** P-2

*Competency Builders:*

9.6.1 Communicate technical information
9.6.2 Interact with supervisors, customers, and coworkers
9.6.3 Process repair/service orders
9.6.4 Document information
9.6.5 Demonstrate teamwork skills
9.6.6 Ensure readability of information

**Competency 9.7: Acquire parts** P-3

*Competency Builders:*

9.7.1 Collect necessary information (e.g., make, model, year, option codes, vehicle identification number [VIN])
9.7.2 Convey information to parts person
9.7.3 Confirm that the part received is the correct one
9.7.4 Verify part price/availability

**Competency 9.8: Demonstrate use of basic measuring tools** P-1

*Competency Builders:*

9.8.1 Perform basic math functions (e.g., addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals)
9.8.2 Identify tools and their uses
9.8.3 Select tools appropriate for given task
9.8.4 Apply metric and English measurement skills
9.8.5 Measure inside/outside diameters, lift, end-play, and backlash
9.8.6 Use digital volt ohmeters and multimeters
9.8.7 Use flowcharts and schematics
9.8.8 Demonstrate basic computer skills (e.g., keyboarding, operating monitor, loading programs)

**Competency 9.9: Perform basic mechanical tasks** P-2

*Competency Builders:*

9.9.1 Identify types, sizes, and strengths of various fasteners and fittings
9.9.2 Drill holes
9.9.3 Practice tap and die techniques
9.9.4 Sharpen drill bits and chisels
9.9.5 Extract broken screws
9.9.6 Repair damaged threads
9.9.7 Practice flaring techniques (single and double)
9.9.8 Assemble basic hydraulic/pneumatic hose and tubing
9.9.9 Practice soldering techniques
9.9.10 Practice wire connection techniques, including soldering and crimping
9.9.11 Perform torquing of fasteners

**Competency 9.10: Perform basic welding and cutting tasks** P-2

*Competency Builders:*

9.10.1 Wear safety gloves, eye protection, and leathers
9.10.2 Practice safety procedures established for welding and oxyacetylene welding (e.g., use welding curtain)
9.10.3 Weld/braze using oxyacetylene equipment
9.10.4 Cut using oxyacetylene equipment
9.10.5 Weld using arc welding equipment
9.10.6 Weld using MIG equipment*
9.10.7 Cut using plasma cutting equipment*
9.10.8 Identify emerging welding techniques*

**Notes:**

# Occupational Competency Analysis Profile:

# Employability

# Unit 1: Career Development

## Competency 1.1: Investigate career options

*Competency Builders:*

1.1.1 Determine interests and aptitudes
1.1.2 Identify career options
1.1.3 Research interests, knowledge, abilities, and skills needed in an occupation
1.1.4 Select careers that best match interests and aptitudes
1.1.5 Identify advantages and disadvantages of career options, including self-employment and nontraditional careers

## Competency 1.2: Utilize career information

*Competency Builders:*

1.2.1 Identify a range of career information resources
1.2.2 Use a range of resources to obtain career information (e.g., handbooks, career materials, labor market information, and computerized career-information delivery systems)
1.2.3 Demonstrate knowledge of various classification systems that categorize occupations and industries (e.g., *Dictionary of Occupational Titles*)
1.2.4 Describe the educational requirements of various occupations
1.2.5 Identify individuals in selected occupations as possible information resources, role models, or mentors
1.2.6 Describe the impact of factors such as population, climate, employment trends, and geographic location on occupational opportunities
1.2.7 Assess differences in the wages, benefits, annual incomes, cost of living, and job opportunties associated with selected career options
1.2.8 Determine labor market projections for selected career options

## Competency 1.3: Participate in a career exploration activity

*Competency Builders:*

1.3.1 Identify career exploration activities (e.g., job shadowing, mentoring, volunteer experiences, part-time employment, and cooperative education)
1.3.2 Compare traits, skills, and characteristics required for specific career choices with individual's traits, skills, and characteristics
1.3.3 Recognize potential conflicts between personal characteristics and career choice areas
1.3.4 Describe the impact of exploration activities on current career choices

## Competency 1.4: Assess the relationship between educational achievement and career planning

*Competency Builders:*

1.4.1 Describe how skills developed in academic and vocational programs relate to career goals
1.4.2 Describe how education relates to the selection of a college major, further training, and/or entry into the job market
1.4.3 Identify skills that can apply to a variety of occupational requirements
1.4.4 Explain the importance of possessing learning skills in the workplace

**Competency 1.5: Develop an individual career plan**

*Competency Builders:*

1.5.1 Identify career goal(s)
1.5.2 Identify worker conditions, education, training, and employment opportunities related to selected career goal(s)
1.5.3 Describe school and community resources available to help achieve career goal(s)
1.5.4 Identify career ladders possible within selected career goal(s)*
1.5.5 Identify additional experiences needed to move up identified career ladders*
1.5.6 Recognize that changes may require retraining and upgrading of employees' skills

**Competency 1.6: Annually review/revise the individual career plan**

*Competency Builders:*

1.6.1 Identify experiences that have reinforced selection of the specific career goal(s) listed on the individual career plan
1.6.2 Identify experiences that have changed the specific career goal(s) listed on the individual career plan
1.6.3 Modify the career goals(s) and educational plans on the individual career plan
1.6.4 Ensure that parents or guardians provide input into the individual career plan process
1.6.5 Identify the correlation between the individual career plan and the actual courses to be taken in high school
1.6.6 Identify the correlation between the individual career plan and postsecondary training, adult education, or employment

# Unit 2: Decision Making and Problem Solving

**Competency 2.1: Apply decision-making techniques in the workplace**

*Competency Builders:*

2.1.1 Identify the decision to be made
2.1.2 Compare alternatives
2.1.3 Determine the consequences of each alternative
2.1.4 Make decisions based on values and goals
2.1.5 Evaluate the decision made

**Competency 2.2: Apply problem-solving techniques in the workplace**

*Competency Builders:*

2.2.1 Diagnose the problem, its urgency, and its causes
2.2.2 Identify alternatives and their consequences in relation to the problem
2.2.3 Recognize multicultural and nonsexist dimensions of problem solving
2.2.4 Explore possible solutions to the problem using a variety of resources
2.2.5 Compare/contrast the advantages and disadvantages of each solution
2.2.6 Determine appropriate action
2.2.7 Implement action
2.2.8 Evaluate results of action implemented

# Unit 3: Work Ethic

**Competency 3.1: Evaluate the relationship of self-esteem to work ethic**

*Competency Builders:*

3.1.1 Identify special characteristics and abilities in self and others
3.1.2 Identify internal and external factors that affect self-esteem
3.1.3 Identify how individual characteristics relate to achieving personal, social, educational, and career goals
3.1.4 Identify the relationship between personal behavior and self-concept

**Competency 3.2: Analyze the relationship of personal values and goals to work ethic both in and out of the workplace**

*Competency Builders:*

3.2.1 Distinguish between values and goals
3.2.2 Determine the importance of values and goals
3.2.3 Evaluate how one's values affect one's goals
3.2.4 Identify own short- and long-term goals
3.2.5 Prioritize own short- and long-term goals
3.2.6 Identify how one's values are reflected in one's work ethic
3.2.7 Identify how interactions in the workplace affect one's work ethic
3.2.8 Identify how life changes affect one's work ethic

**Competency 3.3: Demonstrate work ethic**

*Competency Builders:*

3.3.1 Examine factors that influence work ethic
3.3.2 Display initiative
3.3.3 Demonstrate dependable attendance and punctuality
3.3.4 Demonstrate organizational skills
3.3.5 Adhere to schedules and deadlines
3.3.6 Demonstrate a willingness to learn
3.3.7 Demonstrate a willingness to accept feedback and evaluation
3.3.8 Demonstrate interpersonal skills required for working with and for others
3.3.9 Describe appropriate employer-employee interactions for various situations
3.3.10 Express feelings and ideas in an appropriate manner for the workplace

**Competency 3.4: Demonstrate safety skills**

*Competency Builders:*

3.4.1 Practice safe work habits
3.4.2 Identify safety hazards
3.4.3 Employ preventative safety measures
3.4.4 Demonstrate appropriate care and use of equipment and facilities to ensure safety
3.4.5 Comply with safety and emergency procedures

# Unit 4: Job-Seeking Skills

## Competency 4.1: Prepare for employment

*Competency Builders:*

4.1.1 Identify traditional and nontraditional employment sources
4.1.2 Utilize employment sources
4.1.3 Research job opportunities, including nontraditional careers
4.1.4 Interpret equal employment opportunity laws
4.1.5 Explain the critical importance of personal appearance, hygiene, and demeanor throughout the employment process
4.1.6 Prepare for generic employment tests and those specific to an occupation/organization

## Competency 4.2: Develop a résumé

*Competency Builders:*

4.2.1 Identify personal strengths and weaknesses
4.2.2 List skills and/or abilities, career objective(s), accomplishments/achievements, educational background, work experience, volunteer/community contributions, and organizational memberships
4.2.3 Select an acceptable résumé format
4.2.4 Use correct grammar and spelling and concise wording
4.2.5 Secure references
4.2.6 Complete the résumé

## Competency 4.3: Complete the job application process

*Competency Builders:*

4.3.1 Explain the importance of an application form
4.3.2 Obtain job application forms
4.3.3 Demonstrate appropriate behaviors (e.g., personal appearance, hygiene, and demeanor) for obtaining job application forms in person
4.3.4 Describe methods for handling illegal questions on job application forms
4.3.5 Demonstrate legible written communication skills using correct grammar and spelling and concise wording
4.3.6 Return application to appropriate person
4.3.7 Request interview
4.3.8 Follow up on application status

## Competency 4.4: Demonstrate interviewing skills

*Competency Builders:*

4.4.1 Investigate interview procedures
4.4.2 Demonstrate appropriate behaviors (e.g. appearance, hygiene, and demeanor) for the interview
4.4.3 Demonstrate question-and-answer techniques
4.4.4 Demonstrate methods for handling difficult and/or illegal interview questions
4.4.5 Use correct grammar and concise wording

**Competency 4.5: Secure employment**

*Competency Builders:*

4.5.1 Identify present and future employment opportunities within an occupation/organization
4.5.2 Research the organization/company
4.5.3 Use follow-up techniques to enhance employment potential
4.5.4 Evaluate job offer(s)
4.5.5 Respond to job offer(s)

# Unit 5: Job Retention and Career Advancement Skills

**Competency 5.1: Analyze the organizational structure of the workplace**

*Competency Builders:*

5.1.1 Identify employer expectations regarding job performance, work habits, attitudes, personal appearance, and hygiene
5.1.2 Comply with company policies and procedures
5.1.3 Examine the role/relationship between employee and employer
5.1.4 Recognize opportunities for advancement and reasons for termination
5.1.5 Recognize the organization's ethics.

**Competency 5.2: Maintain positive relations with others**

*Competency Builders:*

5.2.1 Exhibit appropriate work habits and attitudes
5.2.2 Identify behaviors for establishing successful working relationships
5.2.3 Cooperate through teamwork and group participation
5.2.4 Demonstrate a willingness to compromise
5.2.5 Identify methods for dealing with harassment, bias, and discrimination based on race, color, national origin, gender, religion, disability, or age
5.2.6 Cooperate with authority
5.2.7 Accept supervision

**Competency 5.3: Demonstrate accepted social and work behaviors**

*Competency Builders*

5.3.1 Demonstrate a positive attitude
5.3.2 Demonstrate accepted conversation skills
5.3.3 Use good manners
5.3.4 Accept responsibility for assigned tasks
5.3.5 Demonstrate personal hygiene
5.3.6 Demonstrate knowledge of a position
5.3.7 Perform quality work

**Competency 5.4: Analyze opportunities for personal and career growth***

*Competency Builders:*

5.4.1 Determine opportunities within chosen occupation/organization*
5.4.2 Determine other career opportunities outside chosen occupation/ organization*
5.4.3 Evaluate the factors involved in considering a new position within or outside an occupation/ organization*
5.4.4 Exhibit characteristics needed for advancement*

# Unit 6: Technology in the Workplace

**Competency 6.1: Demonstrate knowledge of technology issues**

*Competency Builders:*

6.1.1 Demonstrate knowledge of the characteristics of technology
6.1.2 Demonstrate knowledge of how technology systems are applied
6.1.3 Assess the impact of technology on the individual, society, and environment
6.1.4 Demonstrate knowledge of the evolution of technology
6.1.5 Identify how people, information, tools and machines, energy, capital, physical space, and time influence the selection and use of technology
6.1.6 Identify legal and ethical issues related to technology (e.g., confidentiality, information sharing, copyright protection)

**Competency 6.2: Demonstrate skills related to technology issues**

*Competency Builders:*

6.2.1 Exhibit willingness to adapt to technological change
6.2.2 Utilize technological systems
6.2.3 Utilize a variety of resources and processes to solve technological problems
6.2.4 Employ higher-order thinking skills for solving technological problems
6.2.5 Work as a team member in solving technological problems
6.2.6 Use technology in a safe and responsible manner
6.2.7 Apply science, mathematics, communication, and social studies concepts to solve technological problems
6.2.8 Demonstrate ingenuity and creativity in the use of technology*
6.2.9 Utilize a formal method (systems approach) in solving technological problems*

# Unit 7: Lifelong Learning

**Competency 7.1: Apply lifelong learning practices to individual situations**

*Competency Builders:*

7.1.1 Define lifelong learning
7.1.2 Identify factors that cause the need for lifelong learning
7.1.3 Identify changes that may require the retraining and upgrading of employee's skills
7.1.4 Identify avenues for lifelong learning
7.1.5 Participate in lifelong learning activities

**Competency 7.2: Adapt to change**

*Competency Builders:*

7.2.1 Analyze the causes and effects of change
7.2.2 Identify the effect of change on goals
7.2.3 Identify the importance of flexibility when reevaluating goals
7.2.4 Evaluate the need for lifelong learning experiences in adapting to change

# Unit 8: Economic Education

**Competency 8.1: Analyze how an economy functions as a whole**

*Competency Builders:*

8.1.1 Describe how individuals and societies make choices to satisfy needs and wants with limited resources
8.1.2 Identify how production factors (land, labor, capital, and entrepreneurship) are used to produce goods and services
8.1.3 Illustrate how individuals and households exchange their resources for the income they use to buy goods and services
8.1.4 Explain how individuals and business firms use resources to produce goods and services to generate income
8.1.5 Identify characteristics of command, market, and traditional economies*
8.1.6 Describe how all levels of government assess taxes in order to provide services

**Competency 8.2: Analyze how an economic system is a framework within which decisions are made by individuals and groups**

*Competency Builders:*

8.2.1 List several individuals and groups that make economic decisions at the local, state, and national levels
8.2.2 Identify the important roles that local, state, and national governments play in a market economy

*Continued*

***Competency 8.2:*** ***Analyze how an economic system is a framework within which decisions are made by individuals and groups—Continued***

8.2.3 List examples of how government decisions affect individuals
8.2.4 Identify how geographic locations affect the political and economic systems of the world
8.2.5 Evaluate how markets allocate goods and services
8.2.6 Explain how resources, goods, and services are exchanged in markets
8.2.7 Explain competition and its effect on the market

**Competency 8.3:** **Analyze the importance of making informed personal financial decisions**

*Competency Builders:*

8.3.1 Describe the need for personal management records
8.3.2 Create a personal budget
8.3.3 Create a budget for a family of four for one month
8.3.4 Explain how credit affects personal/family finances
8.3.5 Identify steps to avoid credit problems
8.3.6 Make informed consumer choices in response to personal needs and wants
8.3.7 Identify factors that influence consumer decisions (e.g., advertisements, peer groups, price, and location)
8.3.8 Explain the costs and benefits for individuals of various types of taxation at the local, state, and federal levels

# Unit 9: Balancing Work and Family

**Competency 9.1:** **Analyze the effects of family on work**

*Competency Builders:*

9.1.1 Recognize how family values, goals, and priorities are reflected in the workplace
9.1.2 Identify present and future family structures and responsibilities
9.1.3 Describe personal and family roles
9.1.4 Analyze concerns of working parent(s)
9.1.5 Examine how family responsibilities can conflict with work
9.1.6 Identify ways to resolve family-related conflicts
9.1.7 Explain how to use support systems/community resources to help resolve family-related conflicts

**Competency 9.2:** **Analyze the effects of work on family**

*Competency Builders:*

9.2.1 Identify responsibilities associated with paid and nonpaid work
9.2.2 Compare the advantages and disadvantages of multiple incomes
9.2.3 Explain how work can conflict with family responsibilities
9.2.4 Explain how work-related stress can affect families
9.2.5 Identify family support systems and resources

# Unit 10: Citizenship in the Workplace

**Competency 10.1: Exercise the rights and responsibilities of citizenship in the workplace**

*Competency Builders:*

10.1.1 Identify the basic rights and responsibilities of citizenship in the workplace
10.1.2 Identify situations in which compromise is necessary
10.1.3 Examine how individuals from various backgrounds contribute to the workplace
10.1.4 Demonstrate initiative to facilitate cooperation
10.1.5 Give/receive constructive criticism to enhance cooperation

**Competency 10.2: Prepare to work in a multicultural society**

*Competency Builders:*

10.2.1 Identify ways to live in a multicultural society with mutual respect and appreciation for others
10.2.2 Examine how culture and experience create differences in people
10.2.3 Demonstrate respect for the contributions made by all people
10.2.4 Investigate personal cultural background as a means of developing self-respect
10.2.5 Make personal choices that reduce discrimination, isolation, and prejudice
10.2.6 Work effectively with people irrespective of their race, gender, religion, ethnicity, disability, age, or cultural background

# Unit 11: Leadership

**Competency 11.1: Evaluate leadership styles appropriate for the workplace**

*Competency Builders:*

11.1.1 Identify characteristics of effective leaders
11.1.2 Compare leadership styles
11.1.3 Demonstrate effective delegation skills
11.1.4 Investigate empowerment concepts
11.1.5 Identify opportunities to lead in the workplace

**Competency 11.2: Demonstrate effective teamwork skills**

*Competency Builders:*

11.2.1 Identify the characteristics of a valuable team member
11.2.2 Identify methods of involving each team member
11.2.3 Contribute to team efficiency and success
11.2.4 Determine ways to motivate team members

**Competency 11.3: Utilize effective communication skills**

*Competency Builders:*

11.3.1 Identify the importance of listening
11.3.2 Demonstrate effective listening skills
11.3.3 Demonstrate assertive communication techniques
11.3.4 Recognize the importance of verbal and nonverbal cues and messages
11.3.5 Prepare written material
11.3.6 Analyze written material
11.3.7 Give/receive feedback
11.3.8 Communicate thoughts
11.3.9 Use appropriate language
11.3.10 Follow oral and written instructions
11.3.11 Demonstrate effective telephone techniques
11.3.12 Identify technology in communications

# Unit 12: Entrepreneurship

**Competency 12.1: Evaluate the role of small business**

*Competency Builders:*

12.1.1 Identify the impact of small business on the local economy
12.1.2 Examine the relationship of small business to a national (USA) and global economy
12.1.3 Identify factors that contribute to the success of small business
12.1.4 Identify factors that contribute to the failure of small business
12.1.5 Identify the components of a business plan

**Competency 12.2: Examine entrepreneurship as a personal career option**

*Competency Builders:*

12.2.1 Evaluate personal interests and skills
12.2.2 Compare personal interests and skills with those necessary for entrepreneurship
12.2.3 Determine motives for becoming an entrepreneur
12.2.4 Identify the advantages and disadvantages of owning a small business
12.2.5 Compare business ownership to working for others

## Notes

## Academic Job Profile

# The Purpose of Job Profiling

Developed by American College Testing (ACT), the purpose of the Job Profiling process is to identify the **level** of applied academic skills that, according to business and industry, students must master to qualify for and be successful in their occupation of choice. The results of Job Profile "leveling" can help teachers to better target instruction toward their students' needs.

As part of the Ohio Vocational Competency Assessment (OVCA) program, the Vocational Instructional Materials Laboratory (VIML) at The Ohio State University has conducted Job Profiling workshops in which representatives of business, industry, labor, and community organizations identified the academic skill levels needed by entry-level workers in the occupational areas covered by the OCAPs. The Job Profiling, which was carried out in fall 1994 and spring 1995, was sponsored by the Ohio Department of Education, Division of Vocational and Adult Education.

## OVCA—What Is It?

The Ohio Vocational Competency Assessment (or OVCA) package consists of two assessment components: OCAP and Work Keys. Together they measure entry-level occupational, academic, and employability skills. All OVCA items are criterion-referenced, use a multiple-choice format, and are administered using a traditional paper-and-pencil method. The OVCA is designed to do the following:

- Provide one dimension of a multi-assessment strategy for career passport credentialing
- Evaluate learner readiness for jobs requiring specific occupational, academic, and employability skills
- Assist educators in curriculum development
- Provide state-aggregated learning gain scores to comply with regulations in the Carl D. Perkins Vocational and Applied Technology Act of 1992

**OCAP**. The OCAP component of OVCA assesses students in occupational skills—employment requirements—in a particular occupational area. Assessment is based on the core competencies identified through the OCAP process, and each multiple-choice assessment item is correlated to those essential competencies.

**Work Keys**. The Work Keys component, developed by ACT, measures students' applied academic skills. All OVCA packages contain two Work Keys assessments:

- *Applied Mathematics* measures students' ability to analyze, set up, and solve math problems typically found in the workplace.
- *Locating Information* measures students' ability to use graphic documents to insert, extract, and apply information.

In addition, certain taxonomies will use the following Work Keys assessments:

- *Reading for Information* will be used by Business, Marketing, Home Economics, Health Education, and Cosmetology taxonomies.
- *Applied Technology* will be used by Trade and Industrial and Agricultural Education taxonomies.

Other optional Work Keys assessments, not included in the basic OVCA package, are *Teamwork*, *Listening*, and *Writing*.

Each Work Keys assessment is further broken down into four to five levels of achievement, with higher numbers indicating higher achievement in the assessed skill (descriptions of the levels for each Work Keys assessment are provided on pp. 53-59). For each academic skill, the Job Profiling process identifies the level required for successful entry into an occupational area.

## Job Profiling—How It Works

VIML's Job Profiling process was initiated by mailing surveys to current workers in OCAP occupations all across Ohio. The survey's purpose: to have actual workers in specific occupations rate job tasks according to each task's frequency and criticality—that is, the amount of time spent performing each task relative to other tasks and the importance of each task to overall job performance.

To complete the survey, participants examined OCAP competencies for their occupation. Based on the survey's results, VIML staff produced a list of the most critical competencies in each occupation.

The next stage of Job Profiling was to convene committees of subject-matter experts to perform "leveling," which involved the following tasks:

- Examining the frequency and criticality competency lists for an occupation
- Reviewing the levels associated with each of the seven Work Keys academic skills: *Locating Information, Reading for Information, Applied Mathematics, Applied Technology, Listening, Writing,* and *Teamwork*
- Identifying the level of skill students must master relative to each Work Keys academic skill in order to successfully perform the occupational competencies

Finally, in 1995, the initial leveling of Work Keys academic skills for the occupational area covered by this OCAP was revalidated by the new employer panel convened to update the OCAP (see inside back cover).

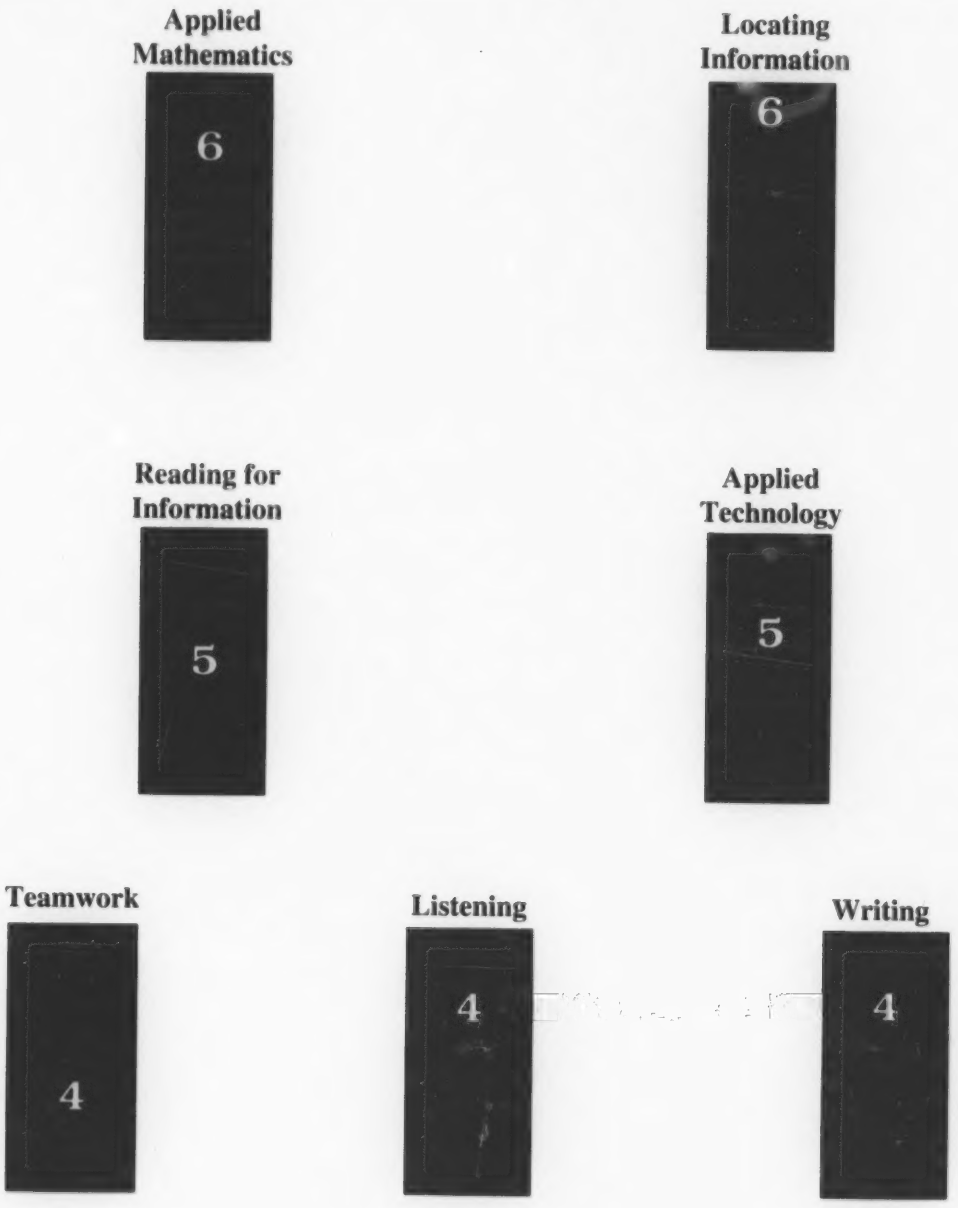
## Example of Job Profiling

For every occupational area, there are shaded graphs to represent each of the seven Work Keys academic skills. Each graph shows the range of levels for that particular skill; the shading represents the academic skill level required by an entry-level worker in that occupation, as determined by the Job Profiling committee. For example:

**Applied Mathematics**

In the example shown, Applied Mathematics has a skill range of 3–7. The required skill level, determined by Job Profiling and shown by the highlighting, is 6.

# Academic Job Profile: Commercial Truck/Equipment Technician




NOTE: Definitions of each level in each of the seven academic skill areas are provided on the pages that follow.

# Levels of Work Keys Defined

The skills needed to achieve each level for each of the seven Work Keys* academic skills are as follows.

## Applied Mathematics

*Applied Mathematics* measures skill in applying mathematical reasoning to work-related problems. There are five levels of complexity, 3 through 7, with Level 3 being the least complex and Level 7 the most complex. The levels build on each other, each incorporating the skills at the preceding levels.

**Level 3**

- Perform basic mathematical operations (addition, subtraction, multiplication, and division) and conversions from one form to another, using whole numbers, fractions, decimals, or percentages.
- Translate simple verbal problems into mathematical equations.
- Directly apply logical information provided to solve problems, including those with measurements and dollars and cents.

**Level 4**

- Perform one or two mathematical operations (such as addition, subtraction, or multiplication) on several positive or negative numbers. (Division of negative numbers is not covered until Level 5.)
- Add commonly known fractions, decimals, or percentages (e.g., ½, .75, 25%) or add three fractions that share a common denominator.
- Calculate averages, simple ratios, proportions, and rates, using whole numbers and decimals.
- Reorder verbal information before performing calculations.
- Read simple charts or graphs to obtain information needed to solve a problem.

**Level 5**

- Look up and calculate single-step conversions within English or non-English measurement systems (e.g., converting ounces to pounds or centimeters to meters) or between measurement systems (e.g., converting centimeters to inches).
- Make calculations using mixed units (e.g., hours and minutes).
- Determine what information, calculations, and unit conversions are needed to find a solution.

**Level 6**

- Calculate using negative numbers, fractions, ratios, percentages, mixed numbers, and formulas.
- Identify and correct errors in calculations.
- Translate complex verbal problems into mathematical expressions, using considerable setup and multiple-step calculations or conversions.

**Level 7**

- Solve problems requiring multiple steps of logic and calculation.
- Solve problems involving more than one unknown, nonlinear functions (e.g., rate of change), and applications of basic statistical concepts (e.g., error of measurement).
- Locate errors in multiple-step calculations.
- Solve problems with unusual content or format, or with incomplete or implicit information.

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## Locating Information

*Locating Information* measures skill in using information taken from workplace graphics such as diagrams, blueprints, floor plans, tables, forms, graphs, charts, and instrument gauges. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. The levels build on each other, each incorporating the skills at the preceding levels.

**Level 3**

- Find one or two pieces of information in elementary workplace graphics, such as simple order forms, bar graphs, tables, flowcharts, and floor plans.
- Fill in one or two pieces of information that are missing from elementary workplace graphics.

**Level 4**

- Find several pieces of information in straightforward workplace graphics, such as basic order forms, line graphs, tables, instrument gauges, maps, flowcharts, and diagrams.
- Summarize and/or compare information and trends in a single straightforward graphic.
- Summarize and/or compare information and trends among more than one straightforward workplace graphic, such as a bar chart and a data table showing related information.

**Level 5**

- Summarize and/or compare information and trends in single complicated workplace graphics, such as detailed forms, tables, graphs, maps, instrument gauges, and diagrams.
- Summarize and/or compare information and trends among more than one complicated workplace graphic, such as a bar chart and a data table showing related information.

**Level 6**

- Make decisions, draw conclusions, and/or apply information to new situations using several related and complex workplace graphics that contain a great amount of information or have challenging presentations (e.g., very detailed graphs, charts, tables, forms, maps, blueprints, diagrams).

## Reading for Information

*Reading for Information* measures skill in reading and understanding work-related reading materials. There are five levels of complexity, 3 through 7, with Level 3 being the least complex and Level 7 the most complex. Although Level 3 is the least complex, it still represents a level of reading skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

**Level 3**

- Identify uncomplicated key concepts and simple details.
- Recognize the proper placement of a step in a sequence of events, or the proper time to perform a task.
- Identify the meaning of words that are defined within a passage.
- Identify the meaning of simple words that are not defined within a passage.
- Recognize the application of instructions from a passage to situations that are described in the passage.

**Level 4**

- Identify details that are more subtle than those in Level 3.
- Recognize the application of more complex instructions, some of which involve several steps, to described situations.
- Recognize cause-effect relationships.

**Level 5**

- Identify the paraphrased definition of jargon or technical terms that are defined in a passage and recognize the application of jargon or technical terms to stated situations.
- Recognize the definition of acronyms that are defined in a passage.
- Identify the appropriate definition of words with multiple meanings.
- Recognize the application of instructions from a passage to new situations that are similar to the situations described in the reading materials.
- Recognize the applications of more complex instructions to described situations, including conditionals and procedures with multiple steps.

**Level 6**

- Recognize the application of jargon or technical terms to new situations.
- Recognize the application of complex instructions to new situations.
- Recognize the less-common meaning of a word with multiple meanings from context.
- Generalize from a passage to situations not described in the passage.
- Identify implied details.
- Explain the rationale behind a procedure, policy, or communication.
- Generalize from a passage to a somewhat similar situation.

**Level 7**

- Recognize the definitions of difficult, uncommon jargon or technical terms from context.
- Generalize from a passage to situations neither described in nor completely similar to those in a passage.

## Applied Technology

*Applied Technology* measures skill in solving problems of a technological nature, involving the basic principles of mechanics, electricity, fluid dynamics, and thermodynamics as they apply to machines and equipment found in the workplace. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. Although Level 3 is the least complex, it still represents a level of applied technology skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

**Level 3**

- Apply the elementary physical principles underlying the operation of uncomplicated systems or tools.
- Recognize and identify relevant aspects of simple problems that involve one uncomplicated system or tool.
- Select appropriate methods or materials needed to solve problems.

**Level 4**

- Recognize, identify, and order relevant aspects of one moderately complex system or more than one uncomplicated system.
- Evaluate alternative solutions to determine the most appropriate one for the situation presented.

**Level 5**

- Solve problems based on one complex system, or one or more uncomplicated tools or systems.
- Understand and apply moderately difficult principles of mechanics, electricity, thermodynamics, and fluid dynamics, in addition to understanding complex machines and systems.
- Recognize, identify, and order relevant aspects of a problem before reaching an appropriate solution.

**Level 6**

- Solve problems that do not contain all the information needed to solve them, and/or in which the information provided may be out of logical order.
- Solve problems that contain extraneous information.
- Solve problems involving one or more tools or systems having a wide range of complexity.
- Apply difficult physical principles.
- Understand and correctly interpret the interaction of several complex systems.

## Listening

*Listening* measures skill in listening to and understanding work-related messages; receiving information from customers, coworkers, or suppliers; and then writing down the information to communicate it to someone else. Students demonstrate their ability to distinguish and communicate critical information and noncritical information. **Critical information** consists of those details that the recipient of the message must have in order to understand the message and act upon it (e.g., names, phone numbers, addresses, times). **Noncritical information** can improve a message by providing details that further explain the message or its tone, but the absence of this noncritical information does not interfere with the recipient's ability to understand and accurately act upon the message. Each *Listening* level describes the **content and quality** of messages students write to describe an audio message.

**Level 0**

- No meaningful information, or totally inaccurate information.

**Level 1**

- Minimal pertinent information; enough context to provide clues as to gist of situation or source of further information.

**Level 2**

- Some pertinent information; may have incorrect critical information, but sketch of the situation is correct.

**Level 3**

- All the critical information that is present is correct; may be missing a few pieces of critical information.

**Level 4**

- All critical information is given and is correct; may be missing subtle details or tone; may have incorrect noncritical information that does not interfere with central meaning.

**Level 5**

- All critical information is present and correct; response conveys insight into situation through tone and/or subtle details.

## Writing

*Writing* measures skill at writing work-related messages; receiving information from customers, co-workers, or suppliers; and then writing down the information to communicate it to someone else. Each *Writing* level rates the **writing mechanics** (such as sentence structure and grammar) **and writing style** of messages students write to describe an audio message.

**Level 0**

- An attempt is made at the message, but the message is completely garbled with no recognizable sentence structure.

**Level 1**

- Message conveyed inadequately; overall lack of proper sentence structure.

**Level 2**

- Message conveyed inadequately; weak sentence structure; large number of mechanical errors.

**Level 3**

- Message conveyed clearly; most sentences complete; some mechanical errors.

**Level 4**

- Message conveyed clearly; all sentences are complete; may have a few minor mechanical errors; may have a choppy style.

**Level 5**

- Message conveyed clearly; good sentence structure; no mechanical errors; highly appropriate for business setting and situation; smooth, logical style.

## Teamwork

*Teamwork* measures skill in choosing behaviors and/or actions that simultaneously support team interrelationships and lead toward the accomplishment of work tasks. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. Although Level 3 is the least complex, it still represents a level of teamwork skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

**Level 3**

- Identify team goals and ways to work with other team members to accomplish those goals.
- Choose actions that support the ideas of other team members to accomplish team goals.
- Recognize that a team is having problems finishing a task and identify the cause of those problems.

**Level 4**

- Identify the organization of tasks and the time schedule that would help accomplish team goals efficiently and effectively.
- Select approaches that accept direction from other team members in order to accomplish tasks and to build and keep up good team relations.
- Identify behaviors that show appreciation for the personal and professional qualities of other team members and respect for their diversity.

**Level 5**

- Identify courses of action that give direction to other team members effectively.
- Choose approaches that encourage and support the efforts of other team members to further team relationships and/or task accomplishment.
- Consider the possible effects of alternative behaviors on both team relationships and team accomplishments and select the one that would best help the team meet its goals.

**Level 6**

- Identify the focus of team activity and select a new focus if that would help the team meet its goals more effectively.
- Select approaches that show the willingness to give and take direction as needed to further team goals (e.g., recognize the organization of team members' tasks that would best serve the larger goals of the team).
- Choose approaches that encourage a team to act as a unit and reach agreement when discussing specific issues.
- Identify actions that would help manage differences of opinion among team members, moving the team toward its goals while valuing and supporting individual diversity.

# Academic Competencies

# Total List of Academic Competencies

Three products of the Ohio Department of Education, Division of Curriculum, Instruction, and Professional Development, describe the academic skills that should be possessed by each student at the end of each grade level:

- *Model Competency-Based Language Arts Program*
- *Model Competency-Based Mathematics Program*
- *Model Competency-Based Science Program*

The following lists were derived from the academic competencies delineated for Grades 9-12 in these documents. Although the competencies are listed separately by grade level in the original documents, the levels were combined—and in some cases refined—for OCAP purposes, any overlap was eliminated, and a numbering system was imposed for ease of reference.

During the course of the OCAP workshops, each of the representatives from business, industry, labor, and community-based organizations was given a copy of these lists of academic competencies and instructed to circle the competencies that an entry-level employee should possess. The results from each panel were tallied to identify those required academic competencies most crucial to entry level in each specific occupational area. The results for this OCAP are presented on pp. 77-78.

## Unit: Communications Skills

### *Subunit: Reading—Structure*

Competencies:

RS1 Exhibit knowledge of language structure
RS2 Recognize that there may be more than one interpretation of reading selections
RS3 Recognize various literary devices (e.g., metaphor, simile, personification, hyperbole, pun, alliteration)
RS4 Recognize and discuss literary elements (e.g., plot, dialogue, theme, setting, characterization)
RS5 Develop and use an increasingly sophisticated vocabulary gained through context
RS6 Apply knowledge of language structure to reading
RS7 Explain why there may be more than one interpretation of reading selections
RS8 Recognize effect of literary devices on meaning
RS9 Analyze author's use of literary elements
RS10 Recognize relationship of structure to meaning
RS11 Describe various interpretations and levels of meaning in reading selections (e.g., symbolism, nuance)
RS12 Characterize author's use of literary devices
RS13 Characterize use of literary techniques (e.g., irony, satire, allegory, onomatopoeia)
RS14 Critique a variety of literature with regard to plot, dialogue, theme, setting, and characterization
RS15 Apply an expanding vocabulary gained through reading
RS16 Explain various interpretations and levels of meaning in reading selections (e.g., symbolism, nuance)
RS17 Analyze use of literary devices (e.g., extended metaphor, simile, personification, hyperbole, pun, alliteration)
RS18 Understand use of literary techniques (e.g., irony, satire, allegory, onomatopoeia)
RS19 Analyze and synthesize pieces of literature with regard to plot, dialogue, theme, setting, and characterization

## *Subunit: Reading—Meaning Construction*

Competencies:

- RM1 Demonstrate ability to recognize appropriate pre-reading strategies
- RM2 Describe effectiveness of a reading selection
- RM3 Read to clarify personal thinking and knowledge
- RM4 Support interpretation of text by locating and citing specific information
- RM5 Develop personal response to a variety of literary works
- RM6 Recognize diverse literary interpretations
- RM7 Engage in self-selected reading activities
- RM8 Confirm and extend meaning in reading by researching new concepts and facts
- RM9 Self-monitor and apply corrective strategies when communication has been interrupted or lost
- RM10 Use features of literary genres to extend meaning
- RM11 Assess effectiveness of a selection read
- RM12 Use reading as a possible problem-solving strategy to clarify personal thinking and knowledge
- RM13 Use knowledge of semantic elements (e.g., figurative language, denotation, connotation, dialect) to clarify meaning when reading
- RM14 Predict, recognize, interpret, and analyze themes based on familiarity with author's work
- RM15 Compare and contrast literary genres
- RM16 Assess validity and quality of selection read (e.g., predict, summarize, analyze, infer)
- RM17 Clarify meaning when reading, using knowledge of literary devices, stylistic diction, and other semantic elements
- RM18 Compare personal reaction to critical assessment of a literary selection
- RM19 Assess validity of diverse literary interpretations
- RM20 Use reference books to find, evaluate, and synthesize information
- RM21 Identify tone of a literary work (e.g., ironic, serious, conversational, humorous)
- RM22 Critique validity of diverse literary interpretations
- RM23 Integrate personal reaction to and critical assessment of a literary selection

## *Subunit: Reading—Application*

Competencies:

- RA1 Select and read material for personal enjoyment and information
- RA2 Read a variety of complete, unabridged works (e.g., self-selected or assigned stories, essays, nonfiction, plays, novels, poetry)
- RA3 Employ various reading strategies (e.g., scanning, skimming, reviewing, questioning, testing, retaining) according to purpose
- RA4 Participate in selection of books, materials, and topics for literature study groups
- RA5 Develop and apply knowledge of the interrelationship of concepts (e.g., construction of webs, graphs, timelines)
- RA6 Read selections from a variety of styles and formats, recognizing that style and format influence meaning
- RA7 Extend value of reading, writing, speaking, viewing, and listening by pursuing, through reading, new concepts and interests developed as a result of these activities
- RA8 Read extensively from the works of a particular author, and explain elements of author's style

## *Subunit: Reading—Multidisciplinary*

Competencies:

- RM1 Connect themes and ideas across disciplines through literature
- RM2 Read to facilitate learning across curriculum
- RM3 Read to develop awareness of human rights and freedom
- RM4 Participate actively in a community of learners

RM5 Recognize and explain interaction between literature and various cultural domains (e.g., social, technological, political, economic)
RM6 Explore and analyze a variety of cultural elements, attitudes, beliefs, and value structures by reading and experiencing our diverse literary tradition, including works by men and women of many racial, ethnic, and cultural groups
RM7 Value thinking and language of others
RM8 Relate literature to historical period about which or in which it was written
RM9 Read to facilitate content learning

## *Subunit: Writing—Structure*

Competencies:

WS1 Develop and expand a repertoire of organizational strategies (e.g., narration, comparison/contrast, and description) through practice and discussion
WS2 Clarify word choice according to audience, topic, and purpose
WS3 Locate and correct errors in usage, spelling, and mechanics (e.g., subject-verb agreement, parallel construction, pronoun reference, punctuation, capitalization, sentence structure) using a variety of resources
WS4 Recognize information gained from primary and secondary sources
WS5 Develop writing that contains ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS6 Use information from a variety of sources to develop an integrated piece of writing
WS7 Evaluate and revise writing to focus on such things as audience, tone, and purpose
WS8 Recognize differences between documentation and reference list styles
WS9 Develop extended pieces of writing that contain ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS10 Select from a repertoire of organization strategies a pattern appropriate to a topic (e.g., narration, example, detail, comparison/contrast, classification)
WS11 Synthesize information from a variety of sources to construct meaning
WS12 Refine word choice and tone according to audience, situation, and purpose
WS13 Appropriately cite information gained from primary and secondary sources
WS14 Use style manuals or software to prepare documentation and reference lists
WS15 Develop effectively organized pieces of expository writing containing strong voice, clear thesis, and well-developed ideas
WS16 Identify organization patterns appropriate to writing topic
WS17 Respond to others' suggested revisions to a writing piece

## *Subunit: Writing—Meaning Construction*

Competencies:

WM1 Demonstrate knowledge of the recursive nature of the writing process by applying it appropriately to various topics, situations, and audiences (e.g., making connections between prior knowledge and new information, consulting other sources)
WM2 Develop criteria for writing evaluation using scoring guides (e.g., rubric/holistic scale, primary trait scoring) and peer/teacher assistance to clarify meaning
WM3 Respond to others' suggested revisions to a piece of writing (e.g., self-question, re-read, revise)
WM4 Use word processing, graphics, and publishing as aids for constructing meaning in writing
WM5 Engage in self-initiated writing activities
WM6 Incorporate personal criteria with generally accepted standards for writing evaluation
WM7 Evaluate, analyze, and synthesize information for writing
WM8 Evaluate own writing using personal and established scoring criteria
WM9 Assess personal/peer revisions to a writing piece
WM10 Recognize and refine personal writing styles

## *Subunit: Writing—Application*

Competencies:

- WA1 Apply appropriate writing techniques (e.g., prewriting, drafting, revising, editing, presenting) suitable for varied writing tasks
- WA2 Use sentence-combining techniques to improve syntactic fluency and maturity
- WA3 Write in response to prompted and self-selected topics in practical, persuasive, descriptive, narrative, and expository domains
- WA4 Develop personal voice in writing
- WA5 Consider audience and purpose for writing
- WA6 Develop criteria for selection and potential development of topic
- WA7 Write in a journal or learning log to clarify personal thinking and knowledge
- WA8 Apply an expanding vocabulary gained through writing
- WA9 Make judicious use of reference sources (e.g., dictionary, thesaurus, online database, encyclopedia)
- WA10 Demonstrate an appreciation for aesthetically pleasing language through word choice and style
- WA11 Apply revising and editing strategies needed for writing task
- WA12 Vary sentence lengths and patterns
- WA13 Refine personal voice in writing
- WA14 Vary styles and formats for intended purpose and audience
- WA15 Apply criteria for selection and development of topic
- WA16 Participate in peer review of writing in progress
- WA17 Use transitions between sentences, ideas, and paragraphs in writing
- WA18 Revise and edit papers extensively in preparation for presentation/publication
- WA19 Develop a variety of genres (e.g, fantasy, science fiction, short stories, poetry)
- WA20 Focus writing and tone on such elements as audience, situation, and purpose
- WA21 Develop topic fully and appropriately
- WA22 Use writing process to clarify personal thinking and knowledge
- WA23 Apply appropriate recursive writing process as suggested by writing task and writer's process
- WA24 Develop an extended piece of writing (e.g., story, narrative poem, autobiography, novel, research paper)
- WA25 Revise writing and tone to assure focus on such elements as audience, situation, and purpose
- WA26 Use writing process to write reflectively

## *Subunit: Writing—Multidisciplinary*

Competencies:

- WM1 Use writing process for learning across curriculum
- WM2 Use writing process to demonstrate knowledge of need for human rights and freedom
- WM3 Value and apply collaborative skills in the writing process
- WM4 Write in response to reading, speaking, viewing, and listening
- WM5 Use multidisciplinary resources in writing projects
- WM6 Use writing process to facilitate learning across curriculum
- WM7 Recognize value of and engage in collaboration in the writing process
- WM8 Use communication processes to develop a published writing piece in collaboration with others
- WM9 Record experiences and observations related to content learning
- WM10 Apply collaborative skills in the writing process
- WM11 Write collaboratively with peers
- WM12 Use cross-disciplinary resources in writing projects

## *Subunit: Listening/Visual Literacy—Structure*

Competencies:

- LS1 Listen to and view a wide variety of genres (e.g, mystery, drama, poetry)
- LS2 Become aware of an author's style through listening to and viewing a variety of works

LS3 Recognize correct and appropriate grammar, diction, and syntax
LS4 Expand vocabulary through listening to and viewing varied media (e.g., recordings, films, music, news broadcasts)
LS5 Recognize beauty of language
LS6 Enhance recognition of an author's style through listening to and viewing a variety of works
LS7 Recognize use and misuse of language in media
LS8 Refine knowledge of style through listening to and viewing multiple works by the same author
LS9 Expand and refine grammar, diction, and syntax through listening
LS10 Compare authors' styles through viewing and listening to their works
LS11 Expand knowledge of complex grammar, diction, and syntax issues

## *Subunit: Listening/Visual Literacy—Meaning Construction*

Competencies:

LM1 Develop critical thinking skills necessary to evaluate media and assess oral presentations
LM2 Compare new oral texts to past experiences and knowledge in order to enhance comprehension
LM3 Recognize how rhythmic patterns, silence, and cadences enhance quality of speech and literature
LM4 Focus listening and viewing on themes and/or plots
LM5 Gather information from listening and viewing experiences to enhance research
LM6 Use critical thinking skills to evaluate media and oral presentations
LM7 Use prior knowledge and experiences to facilitate comprehension of new oral texts
LM8 Identify rhythmic and time patterns in speech and literature
LM9 Identify and analyze themes and/or plots when listening and viewing
LM10 Use information gathered from listening and viewing experiences to expand research
LM11 Enhance use of critical thinking skills to evaluate media and oral presentations
LM12 Consider prior knowledge and experiences when attempting to understand the meaning of new texts
LM13 Appreciate rhythmic and time patterns of speech and literature
LM14 Select viewing and listening materials to support written text
LM15 Evaluate media and oral presentations analytically and critically
LM16 Organize prior knowledge and experiences to comprehend new texts
LM17 Organize and use viewing and listening materials to support written text

## *Subunit: Listening/Visual Literacy—Application*

Competencies:

LA1 Listen attentively during oral reading
LA2 Use media as stimuli for learning and thinking
LA3 Develop knowledge of structure through art, music, and literature
LA4 Use electronic media to enhance and highlight language learning
LA5 Listen and view for entertainment and enjoyment
LA6 Use technology and other media (e.g., videos, posters, maps, graphs, t-shirts) as means of expressing ideas

## *Subunit: Listening/Visual Literacy—Multidisciplinary*

Competencies:

LM1 Facilitate learning across curriculum through critical listening and viewing
LM2 Engage in individual, small-group, and whole-group listening and viewing activities
LM3 Develop language arts (e.g., viewing, listening) projects collaboratively
LM4 Investigate language and cultural differences through listening and viewing activities
LM5 Participate in a community of learners through productive listening

## *Subunit: Oral Communication—Structure*

Competencies:

- OS1 Refine oral communication skills (e.g., voice modulation, eye contact, body language)
- OS2 Demonstrate knowledge of grammar, usage, and syntax when presenting
- OS3 Select topics and vocabulary suitable to audience
- OS4 Organize notes and ideas for speaking (e.g., cause-effect, chronological, exemplification)
- OS5 Use language imaginatively (e.g., word games, puns, limericks)
- OS6 Modulate voice to enhance meaning when interpreting literature orally
- OS7 Organize notes and ideas for formal, semiformal, and informal presentations of information
- OS8 Refine speaking techniques for formal, semiformal, and informal settings
- OS9 Develop repertoire of organizational strategies for presenting information orally
- OS10 Expand vocabulary to fit topic
- OS11 Select topics suitable to audience, situation, and purpose
- OS12 Select appropriate strategies when organizing notes and ideas for speaking

## *Subunit: Oral Communications—Meaning Construction*

Competencies:

- OM1 Make connections between prior knowledge and new information for oral presentations
- OM2 Participate in informal speaking activities (e.g., offering opinions, supporting statements, questions, clarification, entertainment)
- OM3 Use interviewing techniques to gather information
- OM4 Communicate orally to entertain and to inform
- OM5 Participate in group communication activities (e.g., debates, panel discussions, negotiations, book-sharing, roundtables, cooperative/collaborative groups)
- OM6 Take and organize notes when preparing speech/presentation
- OM7 Interpret texts orally to illustrate meaning
- OM8 Respond to needs of various audiences
- OM9 Gather and assess information for speaking
- OM10 Communicate orally to inform and persuade
- OM11 Prepare and deliver formal speech/presentation
- OM12 Participate in a variety of oral interpretations
- OM13 Assess needs of audience, and adjust language and presentation according to their knowledge
- OM14 Analyze and synthesize information for speaking
- OM15 Describe effectiveness of a literary selection
- OM16 Describe topic or idea in order to clarify personal/audience thinking
- OM17 Analyze and synthesize information gathered from a variety of sources (e.g., interviews, hypermedia, reference works) for speaking
- OM18 Describe validity and/or quality of a literary selection and justify selection
- OM19 Interpret orally a variety of literature
- OM20 Describe topic or idea to clarify meaning for others

## *Subunit: Oral Communication—Application*

Competencies:

- OA1 Become proficient at using interviewing techniques
- OA2 Give an oral interpretation for a specific audience
- OA3 Develop and apply oral communication skills for cooperative/collaborative learning
- OA4 Use oral communication for a variety of purposes and audiences (e.g., negotiations, book reviews, rationales)
- OA5 Develop and apply decision-making strategies
- OA6 Practice interviewing techniques
- OA7 Apply interviewing techniques to purposeful interviews
- OA8 Focus oral interpretation on a specific audience

### *Subunit: Oral Communications—Multidisciplinary*

Competencies:

- OM1 Value thinking and language of others
- OM2 Develop oral projects collaboratively
- OM3 Be involved in individual, small-group, and whole-group language activities
- OM4 Participate actively in a community of learners
- OM5 Investigate language and cultural differences through oral language activities

## Unit: Mathematics Skills

### *Subunit: Numbers and Number Relations*

Competencies:

- NR1 Compare, order, and determine equivalence of real numbers
- NR2 Estimate answers, compute, and solve problems involving real numbers
- NR3 Compare and contrast real number system, rational number system, and whole number system
- NR4 Extend knowledge to complex number system, and develop facility with its operation

### *Subunit: Measurement*

Competencies:

- M1 Estimate and use measurements
- M2 Understand the need for measurement and the probability that any measurement is accurate to some designated specification
- M3 Understand and apply measurements related to power and work
- M4 Understand and apply measurement concepts of distance-rate-time problems and acceleration problems with real-world experiments
- M5 Use real experiments to investigate elasticity, heat, sound, electricity, magnetism, light, acceleration, velocity, energy, and gravity
- M6 Use real-world problem situations involving mass and weight
- M7 Use real-world problem situations involving simple harmonic motion
- M8 Establish ratios with and without common units
- M9 Construct and interpret maps, tables, charts, and graphs as they relate to real-world mathematics
- M10 Understand and solve rate-change problems
- M11 Understand and solve right triangle relationships as they relate to measurement—specifically those that deal with the Pythagorean theorem
- M12 Graph and interpret ordered pairs
- M13 Compute total sales from a variety of items
- M14 Comprehend and compute rates of growth or decay
- M15 Comprehend, compute, and interpret real problems involving annuities
- M16 Develop an ability to identify real problems and provide possible solutions
- M17 Express and apply different types of measurement scales
- M18 Determine area and volume

NOTE: The math subunit on problem solving was not included on this list since it should be a continuing thread throughout all instruction rather than a separate set of competencies.

## *Subunit: Estimation and Mental Computation*

Competencies:

- E1 Use estimation to eliminate choices in multiple-choice tests
- E2 Use estimation to determine reasonableness of problem situations in a wide variety of applications
- E3 Estimate shape of graphs of various functions and algebraic expressions
- E4 Use mental computation when computer and calculator are inappropriate

## *Subunit: Data Analysis and Probability*

Competencies:

- D1 Organize data into tables, charts, and graphs
- D2 Understand and apply measures of central tendency, variability, and correlation
- D3 Use curve fitting to predict from data
- D4 Use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty
- D5 Use computer simulations and random number generators to estimate probabilities
- D6 Test hypotheses using appropriate statistics
- D7 Read, interpret, and use tables, charts, and graphs to identify patterns, note trends, draw conclusions, and make predictions
- D8 Identify probabilities of events involving unbiased objects
- D9 Use sampling and recognize its role in statistical claims
- D10 Design a statistical experiment to study problem, conduct experiment, and interpret and communicate outcomes
- D11 Describe normal curve in general terms, and use its properties
- D12 Create and interpret discrete probability distributions
- D13 Understand concept of random variable
- D14 Apply concept of random variable to generate and interpret probability distributions, including binomial, uniform, normal, and chi square

## *Subunit: Algebra*

Competencies:

- A1 Describe problem situations by using and relating numerical, symbolic, and graphical representations
- A2 Use language and notation of functions in symbolic and graphing settings
- A3 Recognize, relate, and use the equivalent ideas of zeros of a function, roots of an equation, and solution of an equation in terms of graphical and symbolic representations
- A4 Describe and use logic of equivalence in working with equations, inequalities, and functions
- A5 Develop graphical techniques of solution for problem situations involving functions
- A6 Explore and describe characterizing features of functions
- A7 Make arguments and proofs in algebraic settings
- A8 Factor difference of two squares
- A9 Determine slope, midpoint, and distance
- A10 Explore and combine rational functions
- A11 Explore factoring techniques
- A12 Solve quadratic equations by factoring and formula
- A13 Set up and solve linear equations
- A14 Solve systems of linear equations with two variables
- A15 Describe geometric situations and phenomena using variables, equations, and functions
- A16 Describe measures of central tendency, mean, median, mode, and variance algebraically and graphically
- A17 Represent inequalities on the number line and in the coordinate plane
- A18 Use coordinate arguments in making geometric proofs

A19 Symbolize transformations of figures and graphs
A20 Explore geometric basis for functions of trigonometry
A21 Graph linear functions
A22 Develop and use vectors to represent direction and magnitude, including operations
A23 Use polar and parametric equations to describe, graph, and solve problem situations
A24 Represent sequences and series as functions both algebraically and graphically
A25 Explore recursive functions and procedures using spreadsheets, other computer utilities, and notions appropriate to these problem situations
A26 Describe and solve algebraic situations with matrices
A27 Describe and use inverse relationship between functions, including exponential and logarithmic
A28 Analyze and describe errors (and their sources) that can be made when using computers and calculators to solve problems
A29 Decide whether problem situation is best solved using computer, calculator, paper and pencil, or mental arithmetic/estimation techniques
A30 Explore relationships between complex numbers and vectors
A31 Make arguments concerning limits, convergence and divergence in contexts involving sequences, series, and other types of functions
A32 Represent transformations in the plane with matrices
A33 Contrast and compare algebras of rational, real, and complex numbers with characteristics of a matrix algebra system
A34 Construct polynomial approximations of a function over specified intervals of convergence
A35 Examine complex numbers as zeros of functions
A36 Translate verbal statements into symbolic language
A37 Simplify algebraic expressions
A38 Use laws and exponents (including scientific notation)
A39 Expand and extend idea of vectors and linear algebra to higher dimensional situations
A40 Use the idea of independent basis elements for a vector space and associated fundamental concepts of finite dimensional linear algebra
A41 Develop and communicate arguments about limit situations
A42 Use matrices to describe and apply transformations
A43 Develop and use polar and parametric equations to represent problem situations
A44 Explore proofs by mathematical induction

## *Subunit: Geometry*

Competencies:

G1 Create and interpret drawings of three-dimensional objects
G2 Represent problem situations with geometric models and apply properties of figures
G3 Apply Pythagorean theorem
G4 Demonstrate knowledge of angles and parallel and perpendicular lines
G5 Explore inductive and deductive reasoning through applications to various subject areas
G6 Translate between synthetic and coordinate representations
G7 Identify congruent and similar figures using transformation with computer programs
G8 Deduce properties of figures using transformations and coordinates
G9 Use deductive reasoning
G10 Explore compass and straightedge constructions in context of geometric theorems
G11 Demonstrate knowledge of and ability to use proof
G12 Use variety of proof techniques (e.g., synthetic, transformational, and coordinate)
G13 Use variety of proof formats, including T-proof (i.e., two-column) and paragraph proof
G14 Explore different proof strategies
G15 Investigate different proofs of theorems
G16 Develop knowledge of an axiomatic system
G17 Apply transformations and coordinates in problem solving
G18 Represent problem situations with geometric models, and apply properties of figures

G19 Deduce properties of figures using vectors
G20 Analyze properties of Euclidean transformations, and relate translations to vectors
G21 Apply vectors in problem solving
G22 Develop further knowledge of axiomatic systems by investigating and comparing various geometries

### *Subunit: Patterns, Relations, and Functions*

Competencies:

P1 Model real-world phenomena with polynomial and exponential functions
P2 Explore relationship between zeros and intercepts of functions
P3 Translate among tables, algebraic expressions, and graphs of functions
P4 Use graphing calculator or computer to generate graph of a function
P5 Explore relationship between a linear function and its inverse
P6 Describe and use characteristics of polynomial functions in problem-solving situations
P7 Explore conic sections, and graph using graphing calculator or computer
P8 Apply trigonometric functions to problem situations involving triangles
P9 Discover general relationships between algebraic description of conic, kind of conic, and special properties of that conic
P10 Explore periodic real-world phenomena using sine and cosine functions
P11 Analyze effects of parameter changes on graphs
P12 Use graphing calculator or computer to graph functions
P13 Develop a knowledge of rational and transcendental functions
P14 Understand connections between trigonometric and circular functions
P15 Use circular functions to model periodic real-world functions
P16 Solve trigonometric equations, and verify trigonometric identities
P17 Understand connections between trigonometric functions and polar coordinates, exponential functions , logarithmic functions, complex numbers, and series
P18 Model real-world phenomena with a variety of functions
P19 Graph using polar coordinates
P20 Explore graphs in three dimensions
P21 Explore functions of several variables
P22 Explore recursive functions using spreadsheets and/or programming languages

## Unit: Science Skills

### *Subunit: Scientific Inquiry*

Competencies:

Q1 Check the appropriateness and accuracy of measures and computations using various strategies (e.g., estimations, unit analysis, determination of significant figures)
Q2 Use ratios, proportions, and probabilities in appropriate problem situations
Q3 Translate information from and represent information in various forms with equal ease (e.g., tables, charts, graphs, diagrams, geometric figures)
Q4 Use existing algebraic formulas and create new ones in appropriate problem-solving situations
Q5 Estimate and justify probabilities of outcomes of familiar situations based on experimentation and other strategies
Q6 Invent apparatus and mechanical tools needed to perform unique tasks in various situations
Q7 Identify, compare, and contrast different modes of inquiry, habits of mind, and attitudes and dispositions
Q8 Design investigations that are safe and ethical (i.e., obtain consent and inform others of potential outcomes, risks, and benefits; and show evidence of concern for the health and safety of humans and non-human species)

Q9 Make and read scale drawings, maps, models, and other representations to aid planning and understanding

Q10 Seek elaboration and justification of data and ideas, and reflect on alternative interpretations of the information

Q11 Use appropriate units for counts and measures

Q12 Create and use databases (electronic and other) to collect, organize, and verify data and observations

Q13 Design and conduct investigations with multiple variables

Q14 Communicate the results of investigations clearly in a variety of situations

Q15 Examine relationships in nature, offer alternative explanations for the observations, and collect evidence that can be used to help judge among explanations

Q16 Trace the development (e.g., history, controversy, and ramifications) of various theories, focusing on supporting evidence and modification with new evidence

Q17 Select, invent, and use tools, including analog and digital instruments, to make and record direct measurements

Q18 Observe and document events and characteristics of complex systems

Q19 Explain the influence of perspective (e.g., spatial, temporal, and social) on observation and subsequent interpretations

Q20 Create multiple representations of the same data using a variety of symbols, descriptive languages, mathematical concepts, and graphic techniques

Q21 Generate testable hypotheses for observations of complex systems and interactions

Q22 Document potentially hazardous conditions and associated risks in selected homes and public areas

Q23 Participate in public debates, relying on documented and verified data to construct and represent a position on scientific issues

Q24 Construct and test models of physical, biological, social, and geological systems

Q25 Read, verify, debate, and, where necessary, refute research published in popular or technical journals of science (e.g., *Discover, Omni, Popular Mechanics*)

Q26 Explore discrepant events and develop and test explanations of what was observed

Q27 Conduct theory-based research using surveys, observational instruments, and other methods

Q28 Modify personal opinions, interpretations, explanations, and conclusions based on new information

Q29 Analyze error and develop explanations in various domains

Q30 Formulate taxonomic schemes based upon multivariate models that help to explain similarities and differences in form, distribution, behavior, survival, and origin of objects and organisms

Q31 Demonstrate various logical connections between related concepts (e.g., entropy, conservation of energy)

Q32 Account for discrepancies between theories and observations

Q33 Analyze the changes within a system when inputs, outputs, and interactions are altered

Q34 Create, standardize, and document procedures

Q35 Determine the sources of significant disparities between the predicted and recorded results, and change research procedures to minimize disparities

Q36 Research, locate, and propose applications for abstract patterns (e.g., fractals, Fibonacci sequences, string theory, orbitals)

Q37 Recognize and utilize classification systems for particles, elements, compounds, phenomena, organisms, and others for exploring and predicting properties and behaviors

Q38 Suggest and defend alternative experimental designs and data explanations (e.g., sampling, controls, safeguards)

Q39 Recognize and communicate differences between questions that can be investigated in a scientific way and those that rely on other ways of knowing

Q40 Draw conclusions based on the relationships among data analysis, experimental design, and possible models and theories

Q41 Suggest new questions as a result of reflection on and discussions about own scientific investigations

Q42 Investigate, assess, and comment on strengths and weakness of the descriptive and predictive powers of science

Q43 Create new information from representations of data in a variety of forms (e.g., symbols, descriptive languages, graphic formats) utilizing a variety of techniques (e.g., interpolations, extrapolations, linear regressions, central tendencies, correlations)

## *Subunit: Scientific Knowledge*

Competencies:

- K1 Investigate various types of dynamic equilibrium (e.g., biological, geological, mechanical, chemical)
- K2 Investigate the relationship between the rates of energy exchange and the relative energy level of components within systems (e.g., trophic levels of ecosystems, osmosis, rate of heating and cooling, storms)
- K3 Investigate patterns in the natural world (e.g., heredity, crystalline structures, population and resource distributions, diffraction, dispersion, polarization)
- K4 Investigate models and theories that help to explain the interactions of components in systems (e.g., conservation of mass, energy, and momentum; foodwebs; natural selection; entropy; plate tectonics; chaos; relativity; social-psychology)
- K5 Investigate degrees of kinship among organisms and groups of organisms
- K6 Investigate the limits of the definition of life, and investigate organisms and physical systems that exist at or near these limits (e.g. viruses, quarks, black holes)
- K7 Investigate estimates and measurements of a wide range of distances and rates of change
- K8 Investigate the historical development of theories of change over time (e.g., natural selection, continental drift, the big bang, geologic change)
- K9 Investigate physical and chemical changes in living and nonliving systems (e.g., photosynthesis, weathering processes, glaciation, thermal effects of materials, energy cells)
- K10 Investigate simulations of nuclear change (e.g., radioactivity, half life, carbon dating)
- K11 Investigate conservation principles associated with physical, chemical, and nuclear changes
- K12 Formulate descriptions of the impacts of various forms of mechanical and electromagnetic waves on various organisms and objects
- K13 Formulate models and hypotheses for patterns in the natural world (e.g., earth structures, transportation systems, migrations, communications, constellations)
- K14 Formulate explanations for the influences of objects and organisms on each other over time
- K15 Formulate and interpret explanations for change phenomena (e.g., mass extinctions, stellar evolution, punctuated equilibrium, molecular synthesis)
- K16 Formulate and interpret explanations for the magnitudes of diversity at different periods of geologic time (e.g., mutation, global cataclysms, continental drift, competition, mass extinctions)
- K17 Formulate interpretations of the structure, function, and diversity in a variety of organisms and physical systems (e.g., DNA and RNA variants, nucleons, interaction particles)
- K18 Formulate understandings of geologic time (e.g., millennia, periods, epochs)
- K19 Formulate an understanding of the historical development of the model of the universe (e g., Aristotle, Ptolemy, Copernicus, Brahe, Kepler, Galileo, Newton, Einstein)
- K20 Formulate explanations and representations of the production, transmission, and conservation of energy in biological and physical systems (e.g., weather, volcanism, earthquakes, electricity, magnetism, cellular respiration)
- K21 Formulate models and hypotheses about patterns in the natural world (e.g., social behavior, molecular structure, energy transformation, entropy, randomness, aging, chaos, hormonal cycles)
- K22 Formulate interpretations of the relationship between energy exchange and the interfaces between components within systems
- K23a Formulate estimations for the range of energies within and between various phenomena (e.g., thermal, electromagnetic, thermonuclear, chemical, electrical)
- K23b Formulate explanations for the historical development of descriptions of motions interactions and transformations of matter and energy (e.g., classical Newtonian mechanics, special and general relativity, chaos)
- K24 Formulate models that can be used to describe fundamental molecular interactions in living and non-living systems (e.g., cell membranes, semiconductors).
- K25 Formulate an understanding of the degree of relationship among organisms and objects based on molecular structure (e.g., proteins, nucleic acids)
- K26 Formulate hypotheses and models that may account for observable events (e.g., electricity and magnetism, gravitation, atoms, bonding, chemical reactions, quantum effects, energy flow on biological systems, predator-prey relationships)

K27 Formulate models and hypotheses about change over time (e.g., natural selection, speciation, punctuated equilibrium, phyleytic gradualism, stellar evolution, plate tectonics, radioactive decay, quantum mechanical theory)
K28 Formulate lists of limitations, and propose refinements of standard classification systems (e.g., periodic table, IUPAC, Linnean, standard model)
K29 Formulate specific cases of limitations and possible exceptions of theories and principles regarding the interactions of moving objects and organisms (e.g., fluid flow in vessels, motion near the speed of light, Heisenberg uncertainty principle, meteorological prediction, local variation and diversity, earthquake prediction, energy transport in cellular respiration)
K30 Formulate plans and contingencies that can be used to accommodate for changes to and stresses on systems (e.g., wildlife and habitat management, corrosion prevention, noise abatement, structure design)
K31 Formulate models of molecular, atomic, ionic, and subatomic structures and the physical and biological implications of these structures (e.g., genes, nucleons, quarks)
K32 Formulate estimates for a wide range of measurements and scales (e.g., angstroms to light years)
K33 Formulate and interpret representations of time from origin to present accounting for phenomena of scale (e.g., smoothness, punctuations, chaos)
K34 Formulate interpretations of the historical development of various theories of possible causes of diversity among physical and biological phenomena (e.g., the works of Aristotle, Mendel, Darwin, McClintock)
K35 Formulate models and hypotheses that can be used to explain the interactions of components within technological and ecological systems

## *Subunit: Conditions for Learning Science*

Competencies:

C1 Participate actively in dialogue about and resolution of community issues
C2 Assess information from various countries in the original language or translated form to ascertain the perspectives of many cultures
C3 Analyze the scientific ideas presented in science fiction stories and films
C4 Perform and repeat investigations to verify data, determine regularity, and reduce the impact of experimental error
C5 Present the results of investigations in a variety of forums
C6 Contribute to the decisions regarding topics for investigation
C7 Use various creative means to communicate interpretations of scientific ideas, concepts, phenomena, and events
C8 Consider the scientific thinking and language of others
C9 Individually and collaboratively produce clearly written representations of investigative results
C10 Fulfill responsibilities as part of a research group
C11 Select and utilize resources by various criteria (e.g., efficiency, effectiveness, health, safety) that are appropriate to the investigations being conducted by groups
C12 Present persuasive argument based on the scientific aspects of controversial issues
C13 Collect, store, retrieve, and manipulate information with available technologies that may range from hand processes up through computer applications
C14 Investigate social issues with a scientific perspective (e.g., human rights, wellness, economics, futurism, environmental ethics)
C15 Keep journals of observations and inferences made over an extended period of time, and reflect upon the impact of these recorded ideas on own thinking and actions
C16 Examine the intellect, perspectives, and ethics of notable scientists
C17 Collect and analyze observations made over extended periods of time and compare these to scientific theories
C18 Create presentations of scientific understandings using diverse modes of expressions
C19 Conduct formal scientific debates in the classroom

C20 Wonder about the likelihood of events that may occur by chance or coincidence
C21 Plan and conduct field trips and experiences for small and large groups
C22 Analyze the historical context that leads to and has led to scientific theories
C23 Seek information on topics of personal scientific interest from a variety of sources
C24 Conduct learner-developed investigations independently and collaboratively over periods of weeks and months
C25 Listen attentively and critically to presentations of scientific information made by others
C26 Conduct analyses of propaganda related to scientific issues
C27 Perform investigations that require observations over varying periods of time
C28 Experience scientific concepts as interpreted by other cultures through multimedia and local and global specialists
C29 Access appropriate technology to perform complicated, time-consuming tasks
C30 Relate historical accounts of science to the cultural context in which they were written
C31 Work as a contributing member of a collaborative research group
C32 Examine the influences of social and political structures and realities that contribute to inquiry about scientific issues
C33 Use technology (e.g., desktop publishing, teleconferencing, networking) to communicate scientific ideas
C34 Explore and analyze a variety of perspectives on science (e.g., works by men and women of many racial, ethnic, and cultural groups)
C35 Lead groups of learners of various ages in designing, planning, and conducting science activities
C36 Respect the scientific thinking of others and self
C37 Recognize and contrast different epistemologies
C38 Develop possible courses of action in response to scientific issues of local and global concern
C39 Determine the validity of research conclusions in relation to the design, performance, and results
C40 Develop multimedia presentations of group and individual research projects and investigations appropriate for a variety of audiences and forums
C41 Produce interesting and scientifically correct stories and present them using various modes of expression
C42 Reflect on the ideas and content found in own journal records
C43 Examine ambiguous results and formulate explanations
C44 Recognize and synthesize the contributions to scientific thought of individuals from many cultures
C45 Construct models and simulations of the component structures and functions of living and nonliving entities
C46 Lead multi-age groups in the examination of and planned resolution for scientific issues
C47 Recognize and choose members of research teams based upon the merit of their ideas and skills
C48 Construct a portfolio of products, documentation, and self-evaluations of own abilities, skills, and experiences
C49 Synthesize scientific information from a variety of sources
C50 Evaluate and prioritize scientific issues based upon risk-benefit analyses
C51 Refine scientific skills from a variety of experiences

## *Subunit: Applications for Science Learning*

Competencies:

A1 Answer student-determined questions by designing databases and drawing inferences from the analyses of the information in these databases
A2 Make personal behavior decisions by interpreting information that has a scientific basis
A3 Propose courses of action that will validate and demonstrate personal understandings of scientific principles
A4 Guide other learners in their understanding of the interactions of technologies and society at various periods in time
A5 Promote and carry out practices that contribute to a sustainable environment

A6 Study and propose improvements in public services and systems in own community
A7 Choose consumer materials utilizing personal and environmental risk and benefit information
A8 Make inferences and draw conclusions using databases, spreadsheets, and other technologies
A9 Do simple troubleshooting on common electrical and mechanical systems, identifying and eliminating possible causes of malfunctions
A10 Construct devices that perform simple, repetitive actions
A11 Investigate the functionality of various geometric shapes in the natural world and the designed world (e.g., translations from spherical to plane representations cause distortions; triangular shapes contribute to rigidity and stability in structures; round shapes minimize boundary for a given capacity)
A12 Make decisions regarding personal and public health
A13 Evaluate the social and ecological risks and benefits resulting from the use of various consumer products
A14 Analyze the contributions of advances in technology through history to own everyday life
A15 Identify and reduce risks and threats to a sustainable environment
A16 Extend the limits of human capabilities using technological enhancements
A17 Use and recognize various propaganda techniques
A18 Solve unique problems using the results of systematic analyses
A19 Choose everyday consumer products that utilize recent innovation and pass appropriate performance criteria
A20 Refine personal career interests through investigations of the diversity of manufacturing, research, service, and invention processes
A21 Predict and investigate the working of toys and tools while controlling and manipulating variables (e.g., friction, gravity, forces)
A22 Write, follow, modify, and extend instructions (e.g., equations, algorithms, formulas, flow diagrams, illustrations)
A23 Create products, make inferences, and draw conclusions using databases, spreadsheets, and other technologies
A24 Predict various scenarios and propose solutions to community issues using scientific information (e.g., actuarial tables, census data, topographic maps, incidence data, climatic data)
A25 Use scientific evidence to consider options and formulate positions about the health and safety of others and self
A26 Search for, use, create, and store objects and information using various strategies and methods of organization and access
A27 Research and write environmental impact statements of own design
A28 Compare school-based science perspectives with those gained through cutting-edge technological applications
A29 Design management plans for natural and human-altered environments (e.g., woodlots, patios, lots, lawns, farmlands, forests)
A30 Refine personal career interests
A31 Promote public awareness of the interaction of technology with social issues
A32 Advocate and propose courses of action for local and global scientific issues using global networks
A33 Use appropriate technologies to prepare and present the findings of investigations incorporating tables, graphs, diagrams, and text
A34 Make informed consumer choices by evaluating and prioritizing information, evidence, and strategies
A35 Develop an informed point of view that allows for validation or refutation of the scientific statements and claims of advocates before pursuing courses of action (e.g., contributing support, signing petitions, casting votes)
A36 Differentiate between observations and inferences in the exploration of evidence related to personal, scientific, and community issues
A37 Develop and write environmental impact, and safety and hygiene management plans
A38 Use technology to collect, analyze, and communicate information (e.g., electronic networks, desktop publishing, remote sensing, graphing calculators, satellite telemetry, and others)
A39 Design, construct, and market inventions

# Academic Competencies: Commercial Truck/Equipment Technician

The Commercial Truck/Equipment Technician OCAP panel of expert workers (see member list on the inside back cover) identified the following academic competencies (from the total list, pp. 62-76) as most crucial to the success of an entry-level commercial truck/equipment technician. It is recommended that these competencies be taught in an applied manner for students enrolled in Commercial Truck/Equipment Technician programs.

## Unit: Communications Skills

### *Subunit: Reading—Structure*

Competencies:

| | |
|---|---|
| RS1 | Exhibit knowledge of language structure |

### *Subunit: Reading—Meaning Construction*

Competencies:

| | |
|---|---|
| RM20 | Use reference books to find, evaluate, and synthesize information |

### *Subunit: Reading—Application*

Competencies:

| | |
|---|---|
| RA1 | Select and read material for personal enjoyment and information |

### *Subunit: Listening/Visual Literacy—Application*

Competencies:

| | |
|---|---|
| LA1 | Listen attentively during oral reading |

### *Subunit: Oral Communication—Structure*

Competencies:

| | |
|---|---|
| OS1 | Refine oral communication skills (e.g., voice modulation, eye contact, body language) |

## Unit: Mathematics Skills

### *Subunit: Measurement*

Competencies:

| | |
|---|---|
| M1 | Estimate and use measurements |
| M2 | Understand the need for measurement and the probability that any measurement is accurate to some designated specification |
| M3 | Understand and apply measurements related to power and work |

## Unit: Science Skills

### *Subunit: Scientific Inquiry*

Competencies:

| | |
|---|---|
| Q1 | Check the appropriateness and accuracy of measures and computations using various strategies (e.g., estimations, unit analysis, determination of significant figures) |
| Q2 | Use ratios, proportions, and probabilities in appropriate problem situations |
| Q3 | Translate information from and represent information in various forms with equal ease (e.g., tables, charts, graphs, diagrams, geometric figures) |
| Q6 | Invent apparatus and mechanical tools needed to perform unique tasks in various situations |
| Q11 | Use appropriate units for counts and measures |
| Q14 | Communicate the results of investigations clearly in a variety of situations |
| Q17 | Select, invent, and use tools, including analog and digital instruments, to make and record direct measurements |
| Q22 | Document potentially hazardous conditions and associated risks in selected homes and public areas |

### *Subunit: Applications for Science Learning*

Competencies:

| | |
|---|---|
| A9 | Do simple troubleshooting on common electrical and mechanical systems, identifying and eliminating possible causes of malfunctions |

**Notes:**

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# Verification Panels

The Vocational Instructional Materials Laboratory wishes to extend thanks and appreciation to the many representatives of business, industry, labor, and community organizations who donated their time and expertise to the identification and revalidation of competencies.

The following panel was responsible for verifying the occupational competencies on the Commercial Truck/ Equipment Technician OCAP, identifying those academic competencies that an entry-level employee should possess, and determining the Work Keys academic skill levels required for successful entry into the occupation:

John A. Barnowski, *Sherwin Williams Co.*, Cleveland, Ohio
Dennis Campbell, *Yellow Freight System*, Columbus, Ohio
Richard A. Cochran, *Cummins Ohio Inc.*, Hilliard, Ohio
John R. Cowan, Sr., *Graham Commercial Truck Center*, Columbus, Ohio
Scott Francis, *Midway Truck Center*, Monroeville, Ohio
Ron Gulbransen, *Cummins Ohio Inc.*, Cincinnati, Ohio
Jim Jares, *Buckeye Freightliner*, Richfield, Ohio
James R. Jones, *Seaway Foodtown Inc.*, Maumee, Ohio
Michael S. Pentz, *Consolidated Freightways*, Akron, Ohio
James W. Roark, *Akron Wheel & Frame Inc.*, Akron, Ohio
John Stelzer, *Kirk Nationalease*, Sidney, Ohio
James P. Timon Jr., *Timon's Certified Car Care Inc.*, Cincinnati, Ohio
David H. Whissel, *Portman Equipment*, Cincinnati, Ohio

The following panel was responsible for verifying the competencies on the Employability OCAP:

Barbara J. Forster, *Nationwide Insurance*, Columbus, Ohio
Joan L. Hall, *Health Management Nursing*, Chesapeake, Ohio
Jane Highland, *Southern Ohio Staffing, Inc.*, Chillicothe, Ohio
Chuck Jackson, *Butech, Inc.*, Salem, Ohio
Garry Kessel, *Medina Auto Parts, Inc.*, Medina, Ohio
Joyce A. McMickens, *Ernst & Young*, Cleveland, Ohio
Julie C. Payeff, *The Andersons Management Corp.*, Maumee, Ohio
Patricia Piper, *Edison Industrial Systems Center*, Toledo, Ohio
Gary F. Rybak, *Red Roof Inns, Inc.*, Hilliard, Ohio